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# APPENDICITIS

AND ITS

## SURGICAL TREATMENT

WITH

*A REPORT OF ONE HUNDRED AND  
EIGHTY-FIVE OPERATED CASES*

BY

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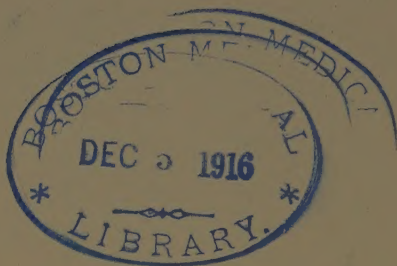
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## PREFACE TO THE THIRD EDITION.

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THE kindness with which this work was received by the profession, and its rapid sale, have led me to review it and to attempt to bring it up to date. The second edition was partly burned in the fire which destroyed the Lippincott Publishing House in Philadelphia in 1899. The scope of the work is much the same as in the other editions, although a considerable amount of new material is added and many other authors have been consulted. The histories have been omitted, and in their place the cases have been classified according to their different clinical forms. The author hopes that the work may meet with continued favor and be of service to the profession at large.

H. MYNTER.

566 DELAWARE AVENUE,  
BUFFALO, N. Y., May 10, 1900.



## PREFACE TO THE FIRST EDITION.

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THE author has attempted in this work to sift the evidence and weigh the testimony for and against the operative treatment of appendicitis. While in the United States this disease is considered an almost exclusively surgical lesion, the same is by no means the case in other countries. We find there men of undoubted authority, and whose opinions are entitled to respectful attention, in the ranks of the conservative physicians, who operate only in exceptional cases and advise against surgical interference as a standard treatment. The author has, however, after careful study of a large number of foreign and American authors and of numerous statistics, come to the same conclusions as most other surgeons, that appendicitis is a surgical lesion and ought to be treated by surgical means, and that medicine is unable to prophesy as to the result in a given case or to prevent gangrene and perforation with resulting fatal peritonitis.

The surgical treatment, therefore, must be considered the conservative treatment, the quickly healing and least dangerous method, and it is radical in so far as a relapse is impossible. The medical treatment is a makeshift, uncertain in its results, unable to prevent the often fatal complications, and therefore dangerous.

For most of the older literature I am indebted to the Surgeon-General's library in Washington. It has been my purpose not to overlook any paper of importance, but, nevertheless, only a small number of English, French, German, and Scandinavian authors have been consulted. The American

literature, I hope, will be found more complete. It is scattered through numerous periodicals, the files of most of which are kept in the library of the University of Buffalo.

The degree of Doctor of Medicine is not conferred in Denmark at graduation as in America. It requires the writing of a monograph showing special studies and individual experience, and is equivalent to *Habilitations Schrift* in Germany, conferring the right to give lectures in the halls of the University as *privat-docent*. Desiring to obtain the degree of Doctor of Medicine from his *alma mater*, the University of Copenhagen, twenty-six years after graduation, the author submitted this monograph to the University, and it was accepted in July, 1897.

H. MYNTER.

566 DELAWARE AVENUE,  
BUFFALO, N. Y., February, 1898.

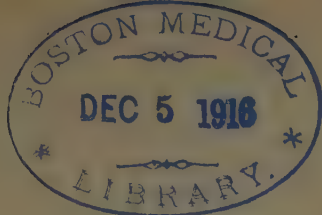
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# APPENDICITIS

AND

## ITS SURGICAL TREATMENT.

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### HISTORICAL INTRODUCTION.

THE names perityphlitis and typhlitis, which were used exclusively until very recent times to denote inflammatory conditions in the right ileocæcal region supposed to depend upon inflammation of the cæcum and its surroundings, are neither anatomically nor pathologically correct. These inflammations are, in the great majority of cases, dependent upon inflammation of the appendix itself, the cæcum only occasionally being primarily attacked, and the abscess is not retrocæcal or pericæcal except in a minority of cases, but intraperitoneal. The importance of the peritoneum as a pathological factor was known from the beginning of this century, but the name did not indicate it. The name peritonitis appendicularis, introduced by Professor With, is perhaps the happiest, as being pathologically, anatomically, and clinically correct. The name appendicitis, however, is already of common usage the world over, although in the majority of cases correct only in the earlier stages of the disease; we shall therefore retain it as the now universally accepted name.

Until 1827 sporadic cases of perforation of the appendix, generally dependent upon foreign bodies, had been noted and published as curiosities. One of the earliest re-

corded cases is by Mestivier<sup>1</sup> in 1759. The patient was a man forty-five years of age, who entered Saint-Andre Hospital in Bordeaux with a fluctuating swelling in the umbilical region. It was incised and a pint of pus removed. The patient died, and at the autopsy an incrustated needle was found in the appendix as the cause of the abscess.

Jadelot,<sup>2</sup> in 1808, reported the case of a boy who died on the tenth day of adynamic fever. At the post-mortem numerous ascarides lumbricoides were found in the ileum, four of which were heaped together in the dilated appendix.

Wegeler,<sup>3</sup> in 1813, reported the case of a boy, eighteen years of age, with fixed pains in the right iliac region, meteorism, weak pulse, and stercoraceous vomiting. He had been sick three days, and died on the fifth day. The cæcum was found in a state of gangrene, which seemed to have begun at the insertion of the processus vermiformis. The appendix was congested and enlarged, and was found to contain, "non sine summa admiratione," some hard bodies, found to be stones, some small, one as large as the egg of a dove. No mention is made of peritonitis being present. Wegeler had been able to find in the literature only one similar case, in which a needle formed the nucleus of a concrement.

A similar concretion, as large as a hazel-nut and containing a hair in the centre, is reported by Vicq d'Azyr<sup>4</sup> in 1814. Bottomley,<sup>5</sup> 1814, mentions the case of a child, seven years of age, who complained suddenly of severe pains in the right side of the abdomen, two inches from the navel, and accom-

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<sup>1</sup> Journal de Méd., Chir. et Pharm., 1759, p. 441, quoted by Maurin.

<sup>2</sup> Reported by Méliér, Journal général de Médecine, de Chir. et Pharm., tome c., 2d Series, No. 39, p. 342.

<sup>3</sup> Historia enteritidis malignæ, et singularis calculosi concrementi, Journal de Médecine, Chir. et Pharm., 1813, tome xxviii. p. 384.

<sup>4</sup> Bibliothèque médicale, 1814, tome xliii. p. 386.

<sup>5</sup> Ibid., tome xlv. p. 278.

panied by considerable fever. The symptoms and pain continued for seven days, when a swelling appeared in the lumbar region. An incision was made and a pint of pus discharged, which contained a kernel of oats, swallowed four months previously. Lonyer-Villermay,<sup>1</sup> 1824, reports two cases of acute inflammation of the appendix with gangrene and death on the fourth and third day.

Mélier,<sup>2</sup> 1827, is, however, the first to group together several observations and draw conclusions from them. He complains that no inquiries have been made into the diseases of the appendix, and that the authors seem to have paid no attention whatever to this organ, because no influence has been attributed to it in the human economy. Nevertheless, he says, observations gathered together prove that this organ in certain cases may be the seat of quickly fatal diseases, and especially from fecal accumulations in its cavity. He reports eight cases, two of which he had observed himself, and gives a short description of the symptoms and differential diagnosis from feculent accumulations in the cæcum. His paper seems, however, not to have attracted attention.

Ferrall,<sup>3</sup> four years later, does not mention the appendix at all, but ascribes the phlegmonous tumors to affections of the cæcum. We may have a painful tumor in the right iliac region, dependent (1) upon the presence of hardened fecal matter in the cæcum, (2) upon inflammation of the walls of the cæcum, with coagulated lymph as the nidus of a future abscess, which may perforate into the cæcum, colon, bladder, rectum, vagina, or lumbar region, or (3) upon per-

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<sup>1</sup> Archives générales de Médecine, 1824, p. 246.

<sup>2</sup> Mémoire et observations sur quelques maladies de l'Appendice cœcale, Journal général de Méd., Chir. et Pharm., 1827, c., 2d Series, No. 39, p. 317.

<sup>3</sup> On Phlegmonous Tumors in the Right Iliac Region, Edinburgh Medical and Surgical Journal, July 1, 1831.

foration of the cæcum from within outward, the abscess being secondary, and leading to the formation of an artificial anus or to a general peritonitis. Dupuytren<sup>1</sup> also, in 1833, ascribes these inflammatory tumors to the cæcum. They terminate in a large number of cases in resolution, and in some cases in an abundant suppuration, which may extend over the whole peritoneum. He does not mention the appendix, but gives a clear description of what we now would call appendicitis.

John Burns,<sup>2</sup> 1837, in an interesting article, states that diseases of the cæcum and appendix have received no consideration in works on practical medicine, although they are of frequent occurrence, always dangerous, often fatal, and characterized by a train of symptoms so peculiar as to render their recognition certain and not difficult. They are apt to be confounded with idiopathic abdominal inflammations, although they in every case depend upon lodgement of fruit-stones and concrements. He gives a clear description of the symptoms, although he believes that they depend more upon the cæcum than upon the appendix. He advises a mild antiphlogistic treatment and to open the abscess when an emphysematous condition is distinguished. He reports eight cases, of which three depended upon perforation of the appendix.

Albers,<sup>3</sup> 1838, goes one step farther in making a distinction between acute typhlitis and perityphlitis. Acute typhlitis he

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<sup>1</sup> Des abcès de la fosse iliaque droite, Leçons orales de Clinique Chirurgicale, 1833, tome iii. p. 330.

<sup>2</sup> Of Inflammation, Chronic Disease, and Perforative Ulceration of the Cæcum and Appendix Vermiformis, Medico-Chirurgical Transactions, London, 1837, vol. xx. p. 200.

<sup>3</sup> Geschichte der Blinddarm-Entzündung, Beobachtungen auf dem Gebiete der Pathologie und pathologischen Anatomie, Bonn, 1838, 2d Theil, Ss. 1 to 23.

considers principally an affection of the mucous membrane of the cæcum, complicating dysentery and enterocolitis; it may, however, occur spontaneously, with severe symptoms, pain, frequent diarrhœa, fever, and quick pulse; the inflammation may extend to the peritoneum, resulting in inflammation of the retrocæcal tissue, although this is rare. The description of the second form, perityphlitis, is that of a typical appendicitis. He believes, however, that it originates primarily in the retroperitoneal tissue, from catching cold or overeating, suppurates, and perforates secondarily into the cæcum or the appendix. "It is not clear, however, why the processus vermiformis so often should be implicated, as the disease generally perforates the cæcum."

Grisolle,<sup>1</sup> 1839, gives an almost correct description of the pathology, in a lengthy article, in which he reports sixty-three cases of phlegmonous tumors in the iliac region, twelve of which he had observed himself. He excludes those inflammations which depend upon puerperium. He objects to the common belief that these inflammations originate from an acute or a chronic inflammation of the mucous membrane of the ileocæcum, extending into the cellular layer, a proceeding which he would consider exceedingly rare, so much more as we do not see such inflammations originate from other mucous membranes. Besides, the inflammation resulting from typhoid fever does not extend into the cellular tissue, even when ulceration and perforation are present. He also objects to the belief that constipation is the exciting cause, as it was found in only one case, and in that the patient died of gangrene of the appendix, "an accident which may result from a kind of strangulation from accumulated fæces in the appendix." Perforations of the cæcum and the appendix

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<sup>1</sup> Histoire des tumeurs phlegmoneuses des fosses iliaques, Archives générales de Médecine, 1839, tome iv. pp. 34, 137, and 293.

occur either spontaneously or after gangrene, dependent upon foreign bodies or hardened fæces, and the resulting inflammation is analogous to that in the cellular tissue around the anus, dependent upon a fissure or ulceration, through which the fecal material may reach the cellular tissue in the neighborhood. If this perforation occupies the posterior wall of the cæcum, which does not possess a peritoneal covering, the fecal material may directly enter the cellular tissue, but a quickly fatal peritonitis will result if the perforation takes place in the anterior wall of the cæcum or in the appendix, unless adhesions form and make the abscess circumscribed. Death may occur in these cases without inflammation appearing in the cellular tissue of the iliac region, or secondary perforation of the abscess may take place into the cellular tissue. As causes of phlegmonous abscesses he mentions contusions, sprains, ball-playing, and particularly perforation of the cæcum and appendix from gangrene.

Rokitansky,<sup>1</sup> 1843, gives a clear description of diseases of the appendix and their terminations in local abscesses, in diffuse peritonitis, and particularly in chronic processes. They are invariably the result of fecal matter and foreign bodies having become lodged and hardened in the appendix. The disease may exist for a long time as blennorrhœa, and is accompanied by thickening of the coat and frequent exacerbations leading to ulceration. In favorable cases the appendix partially or entirely shrivels up, and forms a lead-colored or slate-colored solid body,—*i.e.*, appendicitis obliterans,—or obliteration occurs followed by a metamorphosis analogous to dropsy of the gall-bladder,—*i.e.*, cystic dilatation and empyema. Typhoid and tuberculous affections frequently extend to the appendix, and both may be followed by perforation.

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<sup>1</sup> A Manual of Pathological Anatomy, translated by Sieveking, Philadelphia, 1855, vol. ii. p. 89.



Voltz,<sup>1</sup> 1843, reports six cases with their autopsies, and gives the same pathological description as Rokitansky, particularly of chronic cases. The greatest importance of his paper is in regard to treatment. He advises under all circumstances to avoid purgatives and to use tincture of opium, five drops every quarter-hour, or from half a grain to a grain of opium every hour, and after several days of constipation (seven) to use suppositories and small enemas.

Lewis,<sup>2</sup> 1856, still considers the milder forms of catarrhal inflammation to be of cæcal origin. He gives a clear and correct description of the symptoms, and regards the prognosis as being always unfavorable. At least one-half of the cases are under twenty years of age, four-fifths of them being males. Foreign substances, particularly indurated fecal masses in the appendix, are the immediate cause. In a large proportion of cases fatal peritonitis results within five days; in other cases a localized abscess may be found in different places, according to the position of the appendix. He knows of no case which recovered where diffuse peritonitis was present. All his patients died except one, who recovered after seventy days of illness; a tumor which appeared in the inguinal region was incised and a piece of bone removed. One month later the patient died from another disease, and the appendix was found adherent in the inguinal canal. The importance of his paper consists in his advising surgical treatment. Considering the certainty of death without surgical help, he is in favor of making a free incision down upon the

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<sup>1</sup> Ueber die Verschwärung und Perforation des Processus vermiformis, bedingt durch fremde Körper, Archiv für die gesammte Medicin, 1843, Band iv. S. 305.

<sup>2</sup> A Statistical Contribution to our Knowledge of Abscess and other Diseases consequent upon the Lodgement of Foreign Bodies in the Appendix Vermiformis, with a Table of Forty Cases, New York Journal of Medicine, 1856, vol. i., 3d Series, p. 328.

tumor and evacuating the pus, but it must be done early and not be delayed on account of absence of fluctuation.

Bamberger,<sup>1</sup> in 1858, still maintains the cæcal theory in the lighter cases, while he believes the severe cases depend upon perforation of the cæcum or appendix, most frequently the latter (ten times in twelve cases). He reports ten cases, all fatal, three of which were cases of localized peritonitis and seven of diffuse peritonitis. He advises opium in large doses as the most rational treatment, and uses cathartics only in cases dependent upon coprostasis, when no symptoms of peritonitis are present, or in increasing meteorism with threatening paralysis of the bowels and fecal vomiting.

Leudet,<sup>2</sup> 1859, at last gives up the cæcal theory, and states that perforation of the appendix is much more common than all other perforations of the intestines, that ulceration of the appendix is very frequent in phthisis with ulcerations of the cæcum, and that it is caused by enteric, tuberculous, and typhoid ulcerations and by foreign bodies. It may lead to primary general peritonitis, fortunately rare (he had only one in forty-three cases), or to secondary peritonitis, by rupture of a circumscribed abscess, which is quite frequent among the coils of intestines, or between them and the anterior abdominal wall; or the pus may be found beneath the aponeurosis in the iliac region. These abscesses may also perforate into the cæcum, rectum, vagina, bladder, or outward. As complications he mentions abscesses of the liver and pylephlebitis; he advises against purgatives, and recommends opium and belladonna in large doses.

From Leudet to our days there is little mention of the

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<sup>1</sup> Ueber die Perforation des wurmförmigen Anhangs, Verhandlungen des physicalisch Med. Gesellschaft in Würzburg, 1859, Band ix. S. 123.

<sup>2</sup> Recherches anatomo-pathologiques et cliniques sur l'ulcération et la perforation de l'appendice ileo-cæcal, Archives générales de Médecine, 1859, tome ii. p. 315.

cæcum, and the appendix is recognized as the point of origin in the great majority of cases. The efforts of physicians and surgeons are directed towards improving the prognosis, which during the antiphlogistic treatment was invariably fatal. Operative measures came to the front little by little, opium treatment first having more or less displaced the antiphlogistic treatment.

Willard Parker,<sup>1</sup> 1867, recommends extraperitoneal operation after the fifth and before the twelfth day, and reports four successful cases. Gouley,<sup>2</sup> 1875, goes a step farther, by recommending extraperitoneal operation earlier (seventh or eighth day), even before fluctuation, in order to prevent rupture into the peritoneum. He reported twenty-five cases with two deaths, from different authors. Gurdon Buck,<sup>3</sup> 1876, emphasizes this suggestion, reporting thirteen successful cases from different authors, two of which he had operated on himself. With,<sup>4</sup> 1879, again calls attention to the strict opium treatment with avoidance of all cathartics, emphasizes the importance of the peritoneum, and introduces a new name, peritonitis appendicularis. He reports thirty cases with a mortality of forty per cent. Fitz,<sup>5</sup> 1886, treats exhaustively of the diseases of the appendix, producing many

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<sup>1</sup> An Operation for Abscess of the Appendix Vermiformis Cæci, New York Medical Record, 1867, vol. ii. p. 25.

<sup>2</sup> Transactions of the Medical Society of the State of New York, 1875, p. 345.

<sup>3</sup> On Abscesses in the Lower Abdominal Cavity and its Parietes, New York, 1876.

<sup>4</sup> Festskrift ved Firehundraarsfesten ved Kjöbenhavns Universitet, 1879.

<sup>5</sup> Perforating Inflammation of the Vermiform Appendix, with Special Reference to its Early Diagnosis and Treatment, American Journal of the Medical Sciences, 1886, and Transactions of the Association of American Physicians, 1886.

statistical facts in regard to frequency, foreign bodies, coprolites, and time of occurrence of perforation, and recommends operation.

Henry B. Sands,<sup>1</sup> 1888, reports the first successful case of laparotomy inside of forty-eight hours with extirpation of the appendix and drainage of the abdominal cavity. N. Senn,<sup>2</sup> 1889, reports two cases of laparotomy for chronic recurring cases. Robert Weir,<sup>3</sup> 1889, lays down the rule that if symptoms indicate an increase of the local trouble for forty-eight hours, with or without tumor, laparotomy should be done immediately, and that, if general peritonitis be found during an operation, irrigation and drainage should be employed. McBurney,<sup>4</sup> in 1889, is the first to report a series of early operations. Of his eight cases, seven recovered and one died of peritonitis.

It is, however, first in 1891, after the discussion in the New York State Medical Society, that the surgical treatment suddenly comes to the front. McBurney's paper,<sup>5</sup> read before that society, contains a report of twenty-four early operations, twenty-three of which recovered, and in all of which life was seriously threatened. Six were operated on during the second day, fourteen on the third, two on the fourth, and two at the end of the first week. Since that time an

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<sup>1</sup> An Account of a Case in which Recovery took place after Laparotomy had been performed for Septic Peritonitis due to Perforation of the Vermiform Appendix, New York Medical Journal, February 25, 1888.

<sup>2</sup> A Plea in Favor of Early Laparotomy for Catarrhal and Ulcerative Appendicitis, with Report of Two Cases, Journal of the American Medical Association, November 2, 1889, p. 630.

<sup>3</sup> Medical News, April 27, 1889.

<sup>4</sup> Experience with Early Operative Interference in Cases of Disease of the Vermiform Appendix, New York Medical Journal, December 21, 1889.

<sup>5</sup> Annals of Surgery, April, 1891.

enormous literature has appeared, principally about the treatment of the different forms of appendicitis. In America the fight is led by McBurney, Stimson, Richardson, Gerster, Wyeth, White, Fenger, Fowler, Deaver, Morris, Bull, Meyer, Bryant, Keen, Price, and a host of others, whose writings are found in different medical journals; in Germany, by Sonnenburg, Renvers, Mikulicz, Schede, Finkelstein, and Helferich; in France, by Talamon, Dieulafoy, Maurin, and Tuffier; in Switzerland, by Sahli, Roux, and others; in Sweden, by Lennander, Eckhorn, and Wallis; in England, by Treves, Page, Hawkins, and Kelynack. A review of the writings of all these authors and of the present state of the appendicitis question in different countries will be found in the section on treatment.

### ANATOMY.

The appendix vermiformis is an organ of unknown function, in the form of an elongated cylindrical tube, taking its origin from the cæcum, and consisting of a mucosa rich in lymphoid elements, an outer and an inner muscular coat, and a peritoneal covering in direct communication with that of the cæcum. This extends from the lower end of the cæcum as a triangular fold, the mesenterium or meso-appendix. While, as a rule, the peritoneal covering of the cæcum is incomplete behind, thus bringing the structure in contact with the connective tissues of the iliac fossa, and only rarely forming a complete mesocæcum, the appendix is almost always completely invested with peritoneum. It is found only in man, the man-like apes, and the wombat, and is probably a rudiment of the enormous cæcum of quadrupeds of the rodent type.<sup>1</sup>

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<sup>1</sup> Harrison Allen, *System of Human Anatomy*, Philadelphia, 1893, p. 653.

## LENGTH OF THE APPENDIX.

Bryant<sup>1</sup> states that the average length in males is three and a half inches, in females three and one-tenth inches. The longest in a series of ninety males was eight and one-fourth inches; fifty per cent. were from four to six inches, and four were only between a half-inch and an inch long. The longest in a series of forty-one females was seven inches, the shortest one inch.

Ribbert<sup>2</sup> found the appendix longest in early adult life, after which it tends to become shorter. The relative length is much greater in infants than in adults. Its relation in length to the large intestines is in the new-born as one to ten, in adults as one to twenty. Ferguson<sup>3</sup> gives from two hundred examinations four and a half inches as the average length.

## DIAMETER.

The diameter, according to Bryant,<sup>4</sup> is in males one-fourth of an inch, and, on an average, one-tenth of an inch more than in females. Ferguson<sup>5</sup> gives the diameter as that of a No. 9 bougie, English scale. The greater the diameter the greater the probability of there being fecal matter and foreign material in it. Bryant found fecal matter in seventy per cent. of males and in thirty-five per cent. of females.

## POSITION.

The position of the appendix is not constant, although the insertion into the cæcum is approximately constant. Bryant<sup>6</sup> found the appendix, in one hundred and forty-four examined cases, thirty-two times behind the cæcum, thirty-four times

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<sup>1</sup> *Annals of Surgery*, February, 1893.

<sup>2</sup> *Virchow's Archiv*, 1893.

<sup>3</sup> *American Journal of the Medical Sciences*, January, 1891.

<sup>4</sup> *Loc. cit.*

<sup>5</sup> *Loc. cit.*

<sup>6</sup> *Loc. cit.*



on the inner side of the cæcum and downward towards the pelvis, five times straight down in the iliac fossa, nine times outward and on the outer side of the cæcum, more or less high up, and once on the inner side high up towards the liver. Hawkins<sup>1</sup> found by examination of one hundred bodies the appendix in thirty-eight cases running up along the left border of the cæcum, or lying on the psoas muscle pointing in an upward and inward direction; in twenty-six cases behind the cæcum, either curled up or running up for a variable distance; in seventeen cases down in the pelvis; in nine cases on the outer side of the cæcum; in six cases running almost transversely inward across the psoas, and in four cases curled up below the cæcum. It has, when unusually long, been found lying with its tip on the left psoas muscle. Out of two hundred cases examined by Ferguson<sup>2</sup> he found the appendix nineteen times on the outer side of the cæcum, eleven times downward, eighteen times inward, seventy-five times in relation with the posterior surface of the cæcum, and seventy-seven times in such a way that perforation would take place into the retroperitoneal tissue.

Turner<sup>3</sup> found the appendix, in eighty-three cases in which it was free in the abdominal cavity, fifty-one times hanging down in the pelvis and twenty times passing transversely over the psoas muscle towards the promontory. An especially frequent anomaly is the location behind the cæcum, which occurred in twenty-two cases, in six of which it was wholly or partly extraperitoneal. In such cases, if perforation occurs, we get a perityphlitis in the shape of a phlegmonous inflammation in the retrocæcal tissue; otherwise the inflammation is always intraperitoneal.

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<sup>1</sup> On Diseases of the Vermiform Appendix, London, 1895, p. 17.

<sup>2</sup> Loc. cit.

<sup>3</sup> Quoted by Fowler in Annals of Surgery, May, 1893.



These statistics show how little constancy there is in the position of the appendix, and explain how purulent collections may occupy different positions, according to the position of a perforated appendix.

#### INSERTION.

Bryant<sup>1</sup> found the appendix arising, in forty-seven out of eighty-two male cases, one inch below the ileocæcal valve posteriorly; in ten cases, three-fourths of an inch below and posteriorly; in seven cases, one and one-half inches below and posteriorly; just below in one case; one inch below and back of the valve in five cases; and one and one-half inches below in six cases. In one case only it was inserted to the apex of the cæcum. The result was very much the same in females. He concludes that the origin of the appendix in one-half of all cases, males or females, is one inch below the valve on the posterior surface of the cæcum.

#### MESENTERIOLUM.

The same inconstancy is found in regard to the length of the mesenteriolum as in regard to the position of the appendix. Hawkins<sup>2</sup> found it sometimes absent, so that the appendix was quite free in the abdomen. It often has the appearance of being too short, the result of which is that the appendix is curled spirally and sometimes bent on itself. Wyeth<sup>3</sup> found that the mesenteriolum does not always cover the appendix with peritoneum, but at times leaves a slight surface upon the posterior aspect uncovered, in common with the cæcum. Ferguson<sup>4</sup> found this condition present quite frequently. In two hundred cases the appendix was covered

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<sup>1</sup> Loc. cit.

<sup>2</sup> Loc. cit., p. 18.

<sup>3</sup> Southwestern Medical and Surgical Reporter, July, 1896.

<sup>4</sup> Loc. cit.

by the mesenterium seventy-seven times in such a way that perforation could take place only into the retroperitoneal tissue. Maurin,<sup>1</sup> on the other hand, mentions, from a study of one hundred and twelve cases of all ages, that the appendix in all of them was completely surrounded by serosa and quite free in the abdominal cavity.

In regard to length, Bryant<sup>2</sup> found the appendix, in forty per cent. of examined cases, perfectly free in the abdominal cavity, without a mesenterium, while sixty per cent. had shorter or longer mesenteria. Lockwood and Rolleston,<sup>3</sup> state that the mesenterium seldom reaches more than half or two-thirds of the way along the appendix, and usually gives the impression of being too short. They have observed the following deviations: it is sometimes absent; it may be longer than usual and reach as far as the free end of the appendix; it may have become obliterated by its peritoneum having been spread out in the iliac fossa; it may be hidden away and attached within the ileocaecal or subcaecal fossa; it may have a hole in it through which the small intestines may become strangulated; it may spring from the mesentery, but may also originate from the iliac fossa or caecum, or both, or from the back of the colon. Kelynack<sup>4</sup> has examined eighty cases in regard to its length. In sixty-four cases it extended along the whole length of the appendix, while it covered less than half the appendix in but two cases.

The relation of the mesenterium to the appendix is of great etiological importance. Bryant considers an attack of appendicitis in patients in whom the mesenterium is want-

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<sup>1</sup> Quoted by Talamon, *Appendicitis and Perityphlitis*, translated by Hurd, Detroit, 1893, p. 28.

<sup>2</sup> *Loc. cit.*

<sup>3</sup> *Journal of Anatomy and Physiology*, 1892, vol. xxvi. p. 136.

<sup>4</sup> *Contribution to the Pathology of the Vermiform Appendix*, London, 1893.

ing much more severe and rapidly progressive than in those patients who are provided with mesenteriola reaching to or near to the tip. Gangrene occurs oftener in such cases and always on the distal side of the mesenteriolum. On the other hand, in appendices which are perfectly covered with a mesenteriolum, we shall be more apt to meet a septic lymphangitis extending between the two layers of the mesenteriolum backward, and forming a retroperitoneal abscess. When I have met with gangrene and perforation with subsequent diffuse peritonitis, it has always been in appendices without mesenteriola or on the distal side of a short mesenteriolum.

### HISTOLOGY.

The structure of the appendix is much like that of the cæcum, except that it is rich in lymphoid cells, and has in relation to its size a large absorbent mucous surface. The mucosa consists of a retiform tissue with lymphoid cells in its meshes, either infiltrating the whole mass or found in masses and conglomerations between the glands. The mucosa is bounded by a basement membrane and covered with a columnar epithelium.<sup>1</sup> Numerous tubular glands, the crypts of Lieberkühn, extend into the retiform tissue, and between these the lymphoid masses are found in the deepest part of the mucosa and submucosa. Hawkins states that the amount of lymphatic tissue has no relation to the age of the individual, while Kelyack<sup>2</sup> maintains that in children the lymphoid element is usually more abundant, although it may be found very abundant in those well advanced in life.

The appendix has two muscular coats. The inner one consists of plain muscular fibres disposed in a circular manner and variable in thickness. Hawkins states that it may

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<sup>1</sup> Hawkins, loc. cit., p. 20.

<sup>2</sup> Loc. cit., p. 56.

form a third of the thickness of the wall in normal specimens. The outer muscular coat consists of thinner longitudinal fibres.

The artery, a branch of the superior mesenteric, passes along the free edge of the mesenterium, if this is present; otherwise it extends beneath the peritoneal covering<sup>1</sup> and ramifies in the submucosa. Lennander<sup>2</sup> states that it has two branches, both originating from the superior mesenteric, the smaller one from the anterior side and the larger one from the posterior side of the cæcum; the latter passes down into the mesenterium from one to three millimeters from the wall of the appendix and gives branches to both sides of the appendix. In short mesenteriola it is found close to the wall along its whole length. White<sup>3</sup> mentions a statement of Clado, that a fold of peritoneum, containing an additional artery, passes in females from the right ovary to the mesenterium, thus augmenting the blood-supply to the appendix, and perhaps explaining the less frequent occurrence of appendicitis in females.

The lymphatics pass to a chain of glands in the angle formed by the junction of the appendix with the cæcum.

The nerves take their origin from the superior mesenteric plexus of the sympathetic. The so-called Gerlach's valve is formed by a slight duplication of the mucosa at the orifice, running half-way round. It is in no sense a complete valve.

## FUNCTION.

Richard Berry<sup>4</sup> states that the appendix is represented in mammals by a mass of lymphatic tissue at the apex of the cæcum, and that its function is the production and exudation

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<sup>1</sup> Deaver, A Treatise on Appendicitis, Philadelphia, 1896, p. 30.

<sup>2</sup> Ueber Appendicitis, Wien, 1895, S. 17.

<sup>3</sup> Address on Appendicitis, Therapeutic Gazette, June 15, 1894.

<sup>4</sup> Journal of Pathology and Bacteriology, April, 1895.

of leucocytes. This anatomical fact is of interest in regard to the etiology of appendicitis. Lymphoid tissue is particularly predisposed to acute inflammatory affections, as, for instance, in the tonsils of children; and the frequent attacks of appendicitis in youth may perhaps occasionally be thus explained.

Bland Sutton<sup>1</sup> takes the same view, and thinks that the appendix might be regarded as an abdominal tonsil, possessing adenoid tissue and glands, and that this resemblance might explain pathologically the morbid phenomena. Many people, for instance, suffer from simple tonsillitis, and a similar condition in the appendix would account for the cases of appendicitis which recover under medical treatment. The very acute quinsies, with tonsillar abscess, correspond to sloughing appendicitis. He would also attribute the greater frequency of appendicitis in young people to the fact that affections of adenoid tissue are more common in early life than in adult years.

### ETIOLOGY.

During the first half of the present century abscesses in the ileocæcal region were ascribed to diseases of the cæcum. Isolated cases of perforation of the appendix had been described, but their pathological frequency and importance as an etiological factor had been overlooked, and it is only during the last twenty-five years that the appendix has been recognized as the almost exclusive cause of these inflammations. Hand in hand with this discovery has gone the introduction of early operative treatment and increasing doubt as to the efficacy of medical treatment. The honor of this discovery belongs principally to American surgeons, and the disease is recognized in America as an exclusively surgical lesion. Scarcely

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<sup>1</sup> Lancet, 1891, p. 547.

a surgeon can be found in a large town who cannot show statistics of operations for appendicitis, and uniformly with the same result,—recovery, as a rule, in cases in which there is no diffuse peritonitis. Nor is it to be wondered at that this form—diffuse peritonitis from perforation, primary or secondary—is by most American surgeons looked upon as a calamity which may be prevented by early operation in the majority of cases, and that therefore early operation has been recommended as the proper treatment for most cases, as we are unable to state early in a given case whether it will be a mild one or a serious or even fatal one. The prevalence of the cæcal theory for so long a time may probably be explained by the rarity of post-mortem examinations, and then only in diffuse cases, in which it was difficult to find the primary lesion. It is exceptionally that the cæcum forms the point of origin.

#### FREQUENCY OF ORIGIN IN THE CÆCUM.

Einhorn found in one hundred cases the point of origin in the appendix in ninety-one per cent. and in the cæcum in nine per cent.; Wallis in fifty-two cases found the origin in the appendix in eighty-nine and eight-tenths per cent. and in the cæcum in ten and two-tenths per cent.<sup>1</sup> Renvers<sup>2</sup> found in five hundred and eighty-six autopsies after perityphlitis the appendix perforated in four hundred and ninety-seven cases, and expresses his belief that five-sixths of all fatal cases depend upon perforation of the appendix itself, and that perforation of the cæcum occurs in but thirteen per cent. In another series of two hundred and eighteen autopsies after perityphlitis he found perforation of the cæcum twenty-nine times.

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<sup>1</sup> From Hygieia, reported in Virchow's Jahresbericht der gesammten Medicin, Berlin, 1895, S. 467.

<sup>2</sup> Deutsche Medicinische Wochenschrift, January 29, 1895.



Sonnenburg<sup>1</sup> acknowledges numerous reports in the literature of perforations of the cæcum, particularly from foreign bodies. The large majority are, however, secondary, an abscess perforating into the cæcum. Volkmann thinks that typhlitis and perityphlitis always depend upon perforation of the appendix, save in the case of tuberculosis and typhoid ulcers of the cæcum itself.

Talamon<sup>2</sup> says that early operations show that there never, or almost never, exists inflammation or perforation of the cæcum, and that we are warranted in distrusting old observations, taken at a time when the true state of the appendix was not suspected. Neither the tumor nor the pains nor the inflammatory symptoms are due to any lesion of the walls of the cæcum proper, although, without doubt, the cæcum may be involved, but always in an accessory or secondary manner. The peritoneal covering of the cæcum is always the most rapidly and most profoundly affected, and the fibrinous membranes here thickest and most abundant on account of its intimate relation to the perforated appendix. The abscess frequently bursts into the cæcum, as the appendix often lies along it. The defect is largest on the serosa and smallest on the mucous membrane. The opposite would be the case if perforation took place from the mucosa outward. The tumor, which advocates of the cæcal theory believed to be the cause, is only the result, and appears first after several days. The appendix, he concludes, must primarily be affected in order to produce the symptoms described under the name of typhlitis.

Hawkins<sup>3</sup> states that almost every case of inflammation in the right iliac fossa which has proved fatal has been found to be due to disease of the appendix, and that a perforating

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<sup>1</sup> Deutsche Zeitschrift für Chirurgie, Band xxxviii. S. 159.

<sup>2</sup> Loc. cit., pp. 17 and 23.

<sup>3</sup> Loc. cit., p. 10.



ulceration of the cæcum, though it does certainly occur, is so rare that it may be disregarded. The cæcum may, of course, be affected during typhoid fever, dysentery, or tuberculosis, but the affection is then a part of a general disease and not localized in the ileocæcal region. An ulceration of the cæcum may, nevertheless, occasionally occur under these circumstances, although such ulcers, as a rule, do not perforate.

Perforating ulcers of the cæcum have also been supposed to be due to stercoral typhlitis from retention of fæces. This would in mild cases produce catarrh of the mucous membrane of the cæcum, without ulcerations, but giving symptoms of pain without fever, or with a moderate fever, and a distinct, early appearing tumor. I believe this condition to be more frequent than is supposed. Such cases are almost never fatal, and recover promptly by the use of purgatives. It is true that the symptoms, with the exception of the early tumor, are those of a mild appendicitis, but the etiology is quite different, and the mortality not to be compared with that of true appendicitis. Renvers's statistics of two thousand cases from the German army (to be mentioned later), with a mortality of about four per cent., consist, I believe, largely of such cases.

I must, therefore, agree with Hawkins<sup>1</sup> that there is no evidence in support of the cæcal theory, but that there is a perfect gradation from the cases of sudden, fatal general peritonitis to those with but slight pains and tenderness in the iliac region. Moreover, these degrees alternate in the same subject, a severe and fatal attack of peritonitis following one or more slight attacks, or a more severe attack being followed by several of the milder variety.

The *causes* of appendicitis are many and varied, but sometimes appendicitis occurs without any appreciable cause, at

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<sup>1</sup> Loc. cit., p. 13.

other times we find particular causes. Sautham<sup>1</sup> thinks the most plausible explanation is that which regards the appendix as a diverticulum that readily allows of the accumulation and stagnation of fecal matter. This, mingling with the secretion from the mucous lining, and undergoing fermentative and putrefactive changes, sets up a catarrhal inflammation which may be followed by ulceration and perforation or by thickening of the wall, the latter condition being that most commonly encountered in the recurrent form of the disease. The fecal concretion is the consequence and not the cause of the inflammation; but, once formed, it tends to excite and keep up the recurrent attacks. Treves<sup>2</sup> states that the cause of appendicitis is a catarrhal inflammation going on to ulceration and producing the stricture so often found.

Three particular theories have been brought forward in regard to the origin of appendicitis:<sup>3</sup>

1. Talamon's theory about appendicular colic, dependent upon the entrance of scybala or foreign bodies from the cæcum, and producing muscular contractions in order to expel them. This theory is probably correct only in exceptional cases. Foreign bodies are, as we know, very rare, and the concretions are formed by a slow process in the appendix itself. Treves<sup>4</sup> objects strongly to the term appendicular colic, for which he thinks "there is not one fraction of evidence worth considering." The intensity of the colic must depend upon the power of the irritated muscle, which is but a mere stratum of attenuated fibres, and upon the supply of sensory nerves, which is relatively poor. It is well known that extensive ulcerations and large fecal con-

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<sup>1</sup> The Lancet, June 5, 1897.

<sup>2</sup> British Medical Journal, October 31, 1896.

<sup>3</sup> Le Progrès Médical, October 7, 1899.

<sup>4</sup> Loc. cit.

cretions may exist in the appendix without the patient being conscious of them, and certainly without the production of symptoms which could be ascribed to colic. It is well to remember that Treves operates only in the interval, and, except in fulminant cases, rarely before the fifth day. Berry<sup>1</sup> takes exception to this statement of Treves about "there not being one fraction of evidence worth considering," and would have considered it more courteous to his opponents if Treves had laid that evidence before his audience. He refers to Talamon's and his own writings as perfectly sustaining the occurrence of appendicular colic. McBurney<sup>2</sup> considers appendicular colic one of the distinct clinical forms, and refers to the many early operations performed during attacks of colicky pains, and in which no inflammatory changes have been found nor evidences of recent inflammations discovered. The appendix attempts to rid itself of its contents by muscular contractions. If bends and kinks be present, possibly with dilatation, the muscular contractions will cause severe attacks of pain, accompanied by nausea and vomiting, and yet with normal pulse and temperature. The symptoms are purely mechanical and analogous to the passage of a gall- or ureter-stone.

2. Dieulafoy's theory about a closed sac is correct in a great many cases, although, in my opinion, the cause, as he describes it, is an exception. According to his theory, a coprolite is formed, enlarges, and obstructs the canal, and a closed sac is formed on the distal side of the coprolite, this body acting, so to speak, like a cork in a bottle. The microbes now increase in virulence, penetrate the wall, and produce an inflammation. I do not believe that, as a rule,

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<sup>1</sup> British Medical Journal, November 14, 1896.

<sup>2</sup> International Text-Book of Surgery, Philadelphia, 1900, vol. ii. p. 399.

the coprolite is the cause of the formation of a closed sac. This is formed, in my opinion, by a progressive inflammation leading to cicatricial retraction or stricture, and later to the formation of a coprolite. Moreover, we meet plenty of cases of appendicitis in which neither coprolites nor strictures are present.

3. According to the third theory, that of infection, appendicitis is a spreading inflammation, resulting either from an inflammation in the neighborhood, such as gastro-enteritis or, more rarely, ovaritis, salpingitis, etc., or from an infection of the blood-vessels secondary to a general infection. In either case it is due to bacterial infection. While every case in which pus is present is, of course, infectious, we meet, on the other hand, numerous cases in which there is no pus. I myself am not prepared to acknowledge every case of appendicitis necessarily infectious. We may, for instance, have pure traumatic forms. I consider the mechanical obstruction of greater importance than is usually ascribed to it, and I do not consider cases of appendicitis with strictures, dilatations, coprolites, hydrops, ulcerations, and the chronic and obliterating forms necessarily infectious, even granting that the microbes have played a part during their formation. Let infection be added, and we get immediately gangrenous, perforating, and septic forms. Kümmell<sup>1</sup> and others mention that a coprolite may produce ulceration and perforation. I have frequently met with deep, crater-formed ulcerations, or even perforations, associated with hard coprolites, in which the appearance was that of a slowly progressive, localized ulcer due to pressure. I do not believe that any theory fits all cases. McBurney<sup>2</sup> thinks that the primary cause is probably interference with the drainage of the appendix by

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<sup>1</sup> Berliner Klinische Wochenschrift, April 11, 1898.

<sup>2</sup> New York Polyclinic, January 15, 1897.

aꝑ concretion, a stricture, a kink, or a twist. He has never seen a case in which there was not interference with the drainage. We may, however, with advantage divide the causes into predisposing and exciting ones.

Under predisposing causes I will mention

Anatomical position and structure,

Indigestion and constipation,

Previous attacks,

Constitutional disturbances,

Age, sex, and nationality.

Under exciting causes :

Concrements and foreign bodies,

Micro-organisms,

Strictures, kinks, and mechanical obstructions,

Traumatism,

Overeating,

Actinomycosis.

#### PREDISPOSING CAUSES.

**Anatomical Position and Structure.**—John Wyeth<sup>1</sup> calls attention to the unfortunate position of the appendix as an etiological factor. It is subjected to distention from semi-liquid ingesta by gravitation from the cæcum, while, on the other hand, it empties itself with difficulty on account of its weak muscles. Moreover, the weight of the bowels tends to interfere with the proper supply of blood, by direct pressure on the single artery. People of sedentary habits and with chronic constipation suffer more frequently on account of increased pressure. Finkelstein<sup>2</sup> thinks that the predisposition to stagnation is increased by the disproportion of the length of the appendix to its lumen, it being as sixteen to one, and often much more, and of the disproportion of the size of the

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<sup>1</sup> Southwestern Medical and Surgical Reporter, July, 1896.

<sup>2</sup> Deutsche Zeitschrift für Chirurgie, 1896, Band xxxviii. S. 179.

absorbing and secreting surface to the lumen. Every irritation which is followed by increased secretion will fill the cavity to overflowing, while the swelling of the mucous membrane, particularly at Gerlach's valve, will prevent its discharge into the cæcum. The relatively large absorbing surface favors absorption of the fluid contents, while the solid parts left behind may form the nucleus of a coprolite.

The relation between a movable kidney and appendicitis is interesting as an etiological factor. Edebohls<sup>1</sup> found that over sixty per cent. of patients with a movable right kidney producing symptoms were at the same time suffering from more or less diseased appendices, the affection varying from the mildest forms of congestion and catarrhal appendicitis to the severer types of the disease. He has removed ten diseased appendices thus coexisting with movable right kidney. In the majority of patients the appendicitis improved more or less after nephrorrhaphy, but thirteen patients had one or more attacks after the nephrorrhaphy, ten of whom were operated on. Edebohls explains the relation in the following way. One of the first things that a movable kidney does is to dislocate the duodenum and the head of the pancreas, compressing the superior mesenteric vessels between the head of the pancreas and the bodies of the spinal vertebræ. The interference with the circulation of the appendix, which receives its blood-supply through these vessels, soon leads to chronic congestion, and, that once established, the way for appendicitis is paved. In a later paper<sup>2</sup> he reiterates his former statements, but adds that chronic appendicitis may be the chief symptom of movable right kidney, and that it is present in from eighty to ninety per cent. of women who have a right kidney sufficiently movable to produce symptoms.

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<sup>1</sup> American Journal of Obstetrics, 1895, p. 164.

<sup>2</sup> Post-Graduate, February, 1899.



Symptoms ascribed to movable kidney may really be due to chronic appendicitis. He also states that twenty per cent. of all women have movable kidneys, and that there are symptoms of movable kidneys in four per cent. of all women who suffer from chronic appendicitis.

Another reason for the frequency of diseases in the appendix is that, on account of its anatomical position, it frequently suffers in different severe abdominal lesions, such as typhoid fever, dysentery, and tuberculosis, which, at best, may leave scars and in that way predispose to attacks. Its low vitality, its limited blood-supply, with no anastomosis to make up for the deficiency of supply, and its richness in lymphoid tissue are all characteristics which favor an attack.

**Indigestion and Constipation.**—Constipation, diarrhœa, and digestive disturbances favor the development of appendicitis. The appendix has a relatively low vitality; its one source of blood-supply is easily interfered with by twisting and dragging; it is connected by short and scanty folds of peritoneum with portions of the digestive tract especially liable to changes in form and size, which thus easily produce torsion and tension;<sup>1</sup> furthermore, a micro-organism, capable of great virulence if epithelial exfoliation occur or if stagnation take place, is almost constantly present. Constipation and digestive disturbances alone would probably not produce an appendicitis; but add to them an abnormal position of the appendix, by which stagnation is favored, and the result will sooner or later be an attack of appendicitis.

Fenger,<sup>2</sup> Kümmell,<sup>3</sup> and the late Dr. Iversen<sup>4</sup> emphasize the

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<sup>1</sup> White, An Address on Appendicitis, *Therapeutic Gazette*, June 15, 1894, p. 7.

<sup>2</sup> Remarks on Appendicitis, *American Journal of Obstetrics*, 1893, vol. xxviii. No. 2.

<sup>3</sup> Langenbeck's *Archiv für Klin. Chirurgie*, Band xliii. S. 466.

<sup>4</sup> *Forhandlingerne of Kjöbenhavn's, Med. Selskab*, 20 Januar, 1891.

importance of a catarrhal inflammation of the cæcum as the cause of appendicitis, particularly because fecal concretions are found only in a minority (thirty-nine per cent.) of the perforating cases. They believe that swelling of the mucous membrane leads to stenosis at Gerlach's valve and retention of secretion, and that infection with microbes then easily occurs. Fecal concretions, however, constitute only one of many causes of appendicitis, are often absent, and probably give no symptoms so long as they are small and the communication with the cæcum is free. Iversen believed that this catarrhal inflammation might disappear and perfect recovery take place after one or more attacks, and only slight adhesions be found as proof of a previous inflammation, while Fenger considers it more probable that partial or total obliteration of the appendix occurs as a result of an attack. Lennander<sup>1</sup> found a history of constipation or gastro-intestinal disturbances in twenty-three of his sixty-nine cases; in my previous statistics of seventy-five cases only eight had such a history.

**Previous Attacks.**—Most authors agree that an attack of appendicitis predisposes to new attacks unless the appendix happen to be totally destroyed by gangrene, complicated by a local circumscribed abscess, or else obliterated by destruction of its epithelium and cicatricial retraction of new-formed tissue. The question is intimately connected with another question, whether complete recovery ever occurs after a genuine attack, and with still another question, whether after an attack the appendix ought to be removed as a prophylactic measure. Both of these questions will be discussed later.

Hawkins<sup>2</sup> thinks that every patient who has once had an attack of perityphlitis is liable to a second attack so long as his appendix remains unobliterated or until it is removed.

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<sup>1</sup> Ueber Appendicitis, Wien, 1895.

<sup>2</sup> Loc. cit., p. 111.

In two hundred and fifty cases he found a history of previous attacks in fifty-nine (twenty-three and six-tenths per cent.). Fitz<sup>1</sup> had forty-four per cent. of recurrences, and states that previous attacks are rare only in cases of acute general peritonitis. In forty-seven cases of general peritonitis I have noted previous attacks in seventeen (thirty-six per cent.). All my cases taken together show previous attacks one hundred and one times in one hundred and eighty-five cases (fifty-four per cent.).

Albert Wood,<sup>2</sup> who has made collective investigations in regard to the frequency and time of occurrence of second attacks, for the purpose of deciding the risk to life insurance companies, finds that in cases of circumscribed abscess treated by incision without removal of the appendix recurrence occurs in less than five per cent., and then mostly within a few months. In twenty-seven cases treated by incision without removal of the appendix I have had relapses occur in two cases, in which I removed the appendix during the first twenty-four hours of the new attack.

Fowler<sup>3</sup> says, in regard to chronic appendicitis, that the patient may become apparently convalescent, the pains and all febrile symptoms disappearing. He may even be permitted to resume his vocation. Within a few weeks, or even earlier, a relapse takes place, with symptoms perhaps more violent and threatening than at first. He believes that in these cases the mucous membrane and submucous tissue continue in a condition of subacute inflammation favoring relapses.

Wood<sup>4</sup> gives the following figures showing the percentages

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<sup>1</sup> Boston Medical and Surgical Journal, June 19, 1890, p. 620.

<sup>2</sup> Medical Record, August 22, 1896, p. 257.

<sup>3</sup> Annals of Surgery, January, 1894, p. 39.

<sup>4</sup> Loc. cit., p. 255.

of relapses and recurrences, as given by a few observers. Irish gave fifty per cent. ; Richardson, forty-nine and four-tenths per cent. ; Price, fifty per cent. ; Ranzohoff, thirteen per cent. ; Knaussold, twenty-three per cent. ; Krafft, twenty-two per cent. ; Porter, nine and five-tenths per cent. ; Bryant, from eleven to seventeen per cent. ; Sahli, twenty per cent. ; Gage, thirty-three and five-tenths per cent. ; Rotter, twenty per cent. The average of these figures is twenty-nine and one-tenth per cent. Other authors put the percentage of relapses much higher. Wyeth thinks that, at most, twenty per cent. recover perfectly after one attack and without having a recurrence. Willy Meyer<sup>1</sup> thinks even these figures too high, and believes that ten per cent. of perfect recoveries are nearer the truth. Lennander<sup>2</sup> caps the climax by stating that all the patients whom he has observed for a sufficiently long time have had relapses.

Sonnenburg<sup>3</sup> warns against accepting implicitly physicians' reports of spontaneous recovery, partly because they count cases of simple appendicitis without exudation and partly because they give no reliable information about relapses. Surgeons, he says, often operate on cases which were discharged as recovered after the first attack under medical treatment. Monod<sup>4</sup> says, in regard to medical statistics, that the same patient may have had three, four, or five attacks from which he has recovered, and he figures three, four, or five times in medical reports. He may die in the sixth attack, and is consequently counted five times as a case of recovery and only once as a case of death.

The statistics mentioned above seem, at least, to justify the

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<sup>1</sup> Medical Record, February 29, 1896.

<sup>2</sup> Ueber Appendicitis, Wien, 1895, S. 42.

<sup>3</sup> Deutsche Zeitschrift für Chirurgie, 1891, Band xxxviii. S. 163.

<sup>4</sup> Monod et Vanverts, Appendicite, Paris, 1897, p. 146.

conclusion that previous attacks are an important etiological factor in about thirty per cent. of all cases, be this the result of strictures and mechanical obstructions forming in different parts of the lumen and preventing the appendix from emptying itself, and in that way favoring stagnation, be it from the formation of coprolites always ready to provoke new accidents, or be it that the lesion determined by the first attack persists in a subacute state.<sup>1</sup>

**Constitutional Disturbances.**—The appendix is, as stated, very rich in lymphoid tissue, which, as in the tonsils, is liable to be attacked by acute inflammations, particularly in young individuals. Appendicitis may, therefore, perhaps not always be dependent upon a local affection of the appendix itself.

*Tuberculosis*, too, is apt to attack lymphoid tissue, and might, therefore, be expected to be of frequent occurrence in the appendix. It is, nevertheless, the exception to find tuberculosis as a primary cause of appendicitis. Talamon<sup>2</sup> calls such an affection a special specific appendicitis, absolutely different in its lesions, as in its evolution, from ordinary appendicitis, and, as a rule, starting in the cæcum. Kelynack<sup>3</sup> maintains that it leads to perforation but rarely, and then much later in life than the acute forms of appendicitis. Fenwick and Dodwell<sup>4</sup> found the intestines affected five hundred times in eight hundred and eighty-three cases of phthisis, —i.e., fifty-six per cent.,—of which the ileocæcal region was involved in eighty-five per cent. and was the only part attacked in nine and six-tenths per cent. The appendix itself was the only part of the intestinal canal attacked in seventeen cases,—less than one-half per cent.

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<sup>1</sup> Talamon, loc. cit., p. 69.

<sup>2</sup> Loc. cit., p. 68.

<sup>3</sup> Loc. cit., p. 121.

<sup>4</sup> Quoted by Kelynack, p. 120.

Fitz<sup>1</sup> found eight perforations of the appendix from tuberculosis in two hundred and fifty-seven cases.

Brazil and Frazer have mentioned several cases in which the cause was supposed to be *rheumatism*, and which recovered promptly by the use of sodium salicylate. Beverley Robinson<sup>2</sup> also mentions the relation between rheumatism and appendicitis, and states that the symptoms disappear more quickly after the use of sodium salicylate than after other remedies, and that suppuration may often be prevented by the use of this remedy. In a later article<sup>3</sup> he emphasizes the same statement. It is difficult, however, to see that sodium salicylate could have any influence on suppuration, which depends upon the presence of microbes. Many early cases recover by rest and appropriate treatment alone, and the supposed results of salicylates may only emphasize the correctness of the old sentence, *Post hoc, ergo propter hoc*.

*Typhoid fever, eruptive fevers, and dysentery* are supposed to be predisposing causes of appendicitis, on account of the scars which they may leave behind, and which may keep up the tendency to distention of the intestines and chronic inflammation of the mucosa.<sup>4</sup> They are somewhat more frequent than tuberculosis as an etiological factor. Fitz<sup>5</sup> found five perforations of the appendix in one hundred and sixty-seven typhoid perforations,—*i.e.*, three per cent.,—and in two hundred and fifty-seven perforations of the appendix three cases due to typhoid fever.<sup>6</sup> Kelynack<sup>7</sup> has never seen

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<sup>1</sup> American Journal of the Medical Sciences, October, 1886.

<sup>2</sup> Medical Record, September 14, 1895.

<sup>3</sup> Ibid., February 15, 1896.

<sup>4</sup> Talamon, loc. cit., p. 67.

<sup>5</sup> Transactions of the Association of American Physicians, vol. vi. p. 209.

<sup>6</sup> American Journal of the Medical Sciences, October, 1886.

<sup>7</sup> Loc. cit., p. 124.



a case of perforation, but in one case a distinct typhoid ulceration.

A case of perforation of the appendix due to typhoid ulceration came under my notice at the Sisters of Charity Hospital in Buffalo on August 19, 1896. The patient had been sick twenty-two days; he had had on August 3, 6, and 7 five copious hemorrhages from the bowels, but was considered convalescent, his pulse being 110 and his temperature normal. He suddenly expired, however, on August 19, with symptoms of shock. Post-mortem examination revealed in the ileum and cæcum twenty-three large typhoid ulcers in various stages of healing. Around the appendix, which was perforated, were found sixty grammes of fluid fæces. The appendix had a large perforation in its middle, the peritoneal covering around it being gangrenous. A large, irregular ulcer, of the same appearance as the ulcers in the ileum, but extending through all the tissues to the peritoneum, was found in the appendix. I have not been able to find any statistics bearing upon the frequency of dysentery as an etiological factor.

**Age.**—Appendicitis is undoubtedly most prevalent in early adult life. Turner<sup>1</sup> thinks that this is due to the wider communication with the cæcum in childhood and early adult life, which favors the entrance of fecal material. Fitz,<sup>2</sup> in his statistics of two hundred and fifty-seven cases, found seventy-six per cent. under thirty years of age and almost fifty per cent. under twenty years of age. The youngest was twenty months old, the oldest seventy-eight years.

Hawkins<sup>3</sup> found, in two hundred and twenty-four cases from St. Thomas's Hospital, eleven per cent. from five to ten

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<sup>1</sup> Quoted by Fowler, *Annals of Surgery*, May, 1893.

<sup>2</sup> *American Journal of the Medical Sciences*, October, 1886.

<sup>3</sup> *Loc. cit.*, p. 62.

years of age, forty-three per cent. from ten to twenty, thirty per cent. from twenty to thirty, eight per cent. from thirty to forty, six per cent. from forty to fifty, and nine-tenths per cent. over fifty years of age. Of my own one hundred and eighty-five cases, twelve were between five and ten years of age, fifty-nine were between ten and twenty, sixty-seven were between twenty and thirty, thirty-two were between thirty and forty, ten were between forty and fifty, and five were above fifty years of age.

**Sex.**—Males are more predisposed to appendicitis than females, probably on account of the greater length of the appendix and the poorer blood-supply. White's<sup>1</sup> statement, that a fold of the peritoneum containing an additional artery (according to Clado) passes in females from the right ovary to the mesenteriolum, giving greater blood-supply and preventing gangrene, is probably the correct explanation.

Fitz<sup>2</sup> found eighty per cent. males and twenty per cent. females in statistics of two hundred and fifty-seven cases; Hawkins,<sup>3</sup> seventy-two per cent. males and twenty-eight per cent. females in statistics of two hundred and twenty-four cases. I had one hundred and twenty-six males and fifty-nine females in one hundred and eighty-five cases, respectively sixty-seven and thirty-three per cent.

**Nationality.**—Lange<sup>4</sup> considers appendicitis unusually prevalent in America, and ascribes it to bad habits in eating too much and chewing the food too little, both leading to constipation. As a contributory cause he mentions the hurrying, restless lives, which lead to ignoring of the calls of nature, thereby producing fecal accumulations, with consequent troubles of the mucous membrane of the cæcum.

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<sup>1</sup> Therapeutic Gazette, June 15, 1894, p. 3.

<sup>2</sup> Loc. cit.

<sup>3</sup> Loc. cit., p. 62.

<sup>4</sup> Medical Record, August 29, 1891, p. 245.

The effect would, however, be more in the line of stercoral typhlitis than of appendicitis. I have little doubt that this affection is more prevalent than is generally supposed, and that the appendix is blamed for many troubles which ought to be ascribed to fecal accumulations in the cæcum. The question is of importance in regard to pathology and prognosis, and will be discussed later.

#### EXCITING CAUSES.

Coprolites and foreign bodies, such as stones of cherries and grapes, needles, and worms, constitute a most frequent exciting cause of appendicitis. The distinction between them has no interest except from an etiological point of view. The pointed foreign bodies, such as needles, act by simple traumatism; the round ones form the nucleus, occasionally, of a coprolite and act by pressure-necrosis. Talamon,<sup>1</sup> therefore, distinguishes two forms of appendicitis as originating from this source, traumatic and stercoral. Coprolites are found much more frequently than foreign bodies.

Bryant<sup>2</sup> found, in one hundred and twenty-four cases, abnormal matter in seventy per cent. of the males and in fifty-six per cent. of the females. Renvers<sup>3</sup> found, in four hundred and fifty-nine autopsies, one hundred and seventy-nine coprolites and but sixteen foreign bodies; Fitz<sup>4</sup> found coprolites in forty-seven per cent. of one hundred and thirty-two cases; Maurin<sup>5</sup> in fifty-six per cent. of sixty cases; Krafft,<sup>6</sup> in one hundred and six cases, had thirty-six coprolites, but

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<sup>1</sup> Loc. cit., p. 31.

<sup>2</sup> Annals of Surgery, February, 1893, pp. 170 and 172.

<sup>3</sup> Deutsche Medicinische Wochenschrift, 1891.

<sup>4</sup> American Journal of the Medical Sciences, October, 1886, p. 321.

<sup>5</sup> Quoted by Talamon.

<sup>6</sup> Volkmann's Klinische Vortrage, January, 1889.

only four foreign bodies. Murphy<sup>1</sup> had, in one hundred and forty-one operations, coprolites in thirty per cent. and foreign bodies in three and five-tenths per cent.; I, in one hundred and fifty-eight laparotomies with extirpation of the appendix, found forty-five coprolites and one foreign body. Gallant<sup>2</sup> found, in two hundred operative cases, foreign bodies, exclusive of coprolites, in but one case; Hawkins,<sup>3</sup> none in sixty-seven fatal cases. Mitchell<sup>4</sup> has collected fourteen hundred cases of concretions from various sources, and finds that in about seven per cent. they were true foreign bodies. In two hundred and fifty cases of appendicitis in the Johns Hopkins Hospital during the last ten years there has been found, however, only one foreign body, and that was a segment of a tapeworm. Pins are found quite frequently. Mitchell has collected twenty-eight cases in which a pin was found either at operation or autopsy. These examples are sufficient to show the excess of coprolites over foreign bodies, and the frequency with which the former are found.

Coprolites do not, as was formerly believed, enter from the cæcum, but are formed in the appendix itself, and do not, after all, consist of fæces, except perhaps in the centre, but of bacilli, inspissated mucus, and different salts, colored with fecal matter. The course of the appendix is often found in a direction diametrically opposite that of the cæcum, the opening into the appendix is small and oblique, and it has been shown experimentally to be very difficult to force fluids, even water, from the cæcum into the appendix. The experiments of Herman<sup>5</sup> also seem to prove that coprolites are formed in the appendix itself. He doubly severed a small

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<sup>1</sup> Journal of the American Medical Association, March, 1894.

<sup>2</sup> Medical Record, February 15, 1896.

<sup>3</sup> Loc. cit., p. 37.

<sup>4</sup> Johns Hopkins Hospital Bulletin, January to March, 1899.

<sup>5</sup> Archiv für die gesammte Physiologie, 1890.

part of the intestine, sutured both ends, after having first thoroughly cleaned the lumen, and thereafter sutured the bowel again. Everything which later was found in this little sausage-like piece of intestine must necessarily have originated from secretion of the bowel itself. He found in such a piece of bowel of a dog, killed sixteen days after the operation, a greenish-gray, solid mass, which looked like dry fæces in an icteric patient, but more homogeneous. The concrement contained bacteria, leucocytes, mucin, and fecal coloring-matter. Berry<sup>1</sup> saw a similar paste-like mass form in a centrally ligated appendix. He concludes, therefore, that concrements in the appendix form in the appendix itself and are due to secretion from the appendix. Ribbert<sup>2</sup> states that but very small concrements consist of fecal particles. In larger concrements the centre only is fecal material, while the rest consists of concentric layers of mucus as soon as they surpass the normal diameter of the lumen of the appendix and commence to produce dilatation. This has also been proved microscopically by sections through a hardened appendix containing a concrement. Finkelstein,<sup>3</sup> too, considers the concrements to be secondary formations in the appendix, as their concentric structure also seems to prove. Lockwood<sup>4</sup> shows in a recent paper on the pathology and treatment of appendicitis that fecal concretions consist principally of bacterial masses, a point which has not been demonstrated by any other investigator. He calls attention to the analogy between their formation and that of gall-stones. He points out that they are always associated with general ulceration of the mucosa, that the concretion is not necessarily the cause of the ulceration, but that both the concretion and the ulceration

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<sup>1</sup> Loc. cit.      <sup>2</sup> Virchow's Archiv, 1893.

<sup>3</sup> Archiv für Klinische Chirurgie, Band xxxix.

<sup>4</sup> British Medical Journal, January 27, 1900.

owe their origin to the same cause,—namely, bacterial accumulation within the appendix. Talamon<sup>1</sup> is the only author I have come across who still holds that coprolites are formed in the cæcum. If formed in the appendix, they ought to have an elongated, cylindrical form, he maintains, and not be round. His views are evidently erroneous, as in the large majority of cases the coprolites are elongated and conform to the lumen of the appendix.

The action of the concretions is partly stenosis of the lumen, producing retention of mucus, partly irritation of the mucous membrane, followed by swelling with increased secretion and dilatation. Ulceration does not occur until the fecal mass acquires a certain degree of hardness, and thereby exercises a considerable degree of pressure upon the mucous membrane.<sup>2</sup> A large concretion is in itself a mechanical peril. It may cause a perforation of the appendix in its vicinity or gangrene of the part beyond.<sup>3</sup> The hardness depends upon a deposition of carbonate and phosphate of lime upon the surface of the concrement. Reflex contraction of the muscles takes place, producing symptoms of appendicular colic, by which the pressure is increased, with the result that the epithelium is destroyed and the submucous tissue and finally the muscular coats disappear by pressure-necrosis. In some cases, however, there is no ulceration, but simply atrophy. Volkmann,<sup>4</sup> too, considers them to be the usual cause of typhlitis and perityphlitis, and therefore advises their removal by operation, if we aim at perfect recovery.

**Microbes.**—*Bacillus coli communis* is normally present in the bowels, and is, as a rule, innocent; but it becomes viru-

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<sup>1</sup> Loc. cit., p. 32.

<sup>2</sup> Hawkins, loc. cit., pp. 34 and 35.

<sup>3</sup> Lockwood, *British Medical Journal*, January 27, 1900.

<sup>4</sup> *Deutsche Medicinische Wochenschrift*, 1889, No. 36, S. 753.



lent when the bowel is the seat of inflammation, strangulation, or œdema, and sometimes when diarrhœa or even constipation only is present.<sup>1</sup> Its distribution is not confined to the bowel. Welsh<sup>2</sup> found it present in one or more organs of the body in thirty-five out of about two hundred autopsies. He supposes that a lesion of the mucous membrane of the bowel had opened the way for the invasion of the bacillus into the blood-vessels or lymphatics, and hence into various organs. He has found it in blood, lung, spleen, kidney, peritoneum, bile-duct, gall-bladder, liver, lymphatic glands, testicle, tonsil, brain, and wounds. As a general rule, suppuration has been found whenever it was present, but in a number of cases it has been demonstrated in various organs without any noteworthy lesion. There is, therefore, no evidence that it does harm in these cases, although it cannot be stated positively that it is innocuous. Hence pathogenic powers may be attributed to it only when other causes of inflammation can be excluded. Welsh is inclined to the belief that it is innocent so long as it is surrounded by a healthy mucous membrane, but that it migrates and becomes pyogenic so soon as the mucous membrane is injured or inflamed. Other observations seem to prove that a lesion of the mucous membrane is not necessary, but that the bacillus may migrate through the intact wall and produce peritonitis. An observation of Fränkel, quoted by Hawkins, points in this direction. He injected caustics into the peritoneums of rabbits, producing peritonitis with an exudation which at first was sterile, but later, when purulent, became rich in colon bacilli. Hodenpyl<sup>3</sup> found in some cases colonies of the bacilli in the wall of the appendix, surrounded by exudates,

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<sup>1</sup> Hawkins, loc. cit., pp. 71 and 72.

<sup>2</sup> Medical News, December 12, 1891, p. 670.

<sup>3</sup> New York Medical Journal, December 30, 1893, p. 777.

but without any lesion of the mucous membrane. Hawkins<sup>1</sup> considers cases of idiopathic peritonitis probably due to migration of the colon bacillus through the wall of the bowel, although he acknowledges that it may not always be possible to detect disease of the mucous membrane of the appendix except with the microscope.

The colon bacillus is by no means confined to man. Marshall Flint,<sup>2</sup> of Chicago University, has examined bacteriologically the fæces of twenty-eight animals in Lincoln Park Zoölogical Garden. In fourteen of these he found the bacillus, either in pure culture or in numbers greatly preponderating over other forms present. All the carnivorous animals, with the exception of the wild-cat, contained the bacillus, and it was observed not uncommonly in the herbivora; it has also been found in the lower vertebrata, such as frogs and turtles.

That the colon bacillus is the most important etiological factor of appendicitis and peritonitis has been proved by numerous investigations and experiments. Hodenpyl<sup>3</sup> examined bacteriologically eleven cases, and found the bacillus coli in a pure culture in them all. In thirty-two out of thirty-five collected cases the bacillus coli was the only germ present. Bristow<sup>4</sup> got a pure culture from the fresh exudations of lymph from the outer side of the appendix, also from the wall itself, from peritoneal exudation, and appendicular abscesses, both in the appendix itself and after perforation. Guinea-pigs died in twenty-four hours after injection of this culture into the peritoneal cavity, and new cultures grew by inoculation from the peritoneal exudation.

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<sup>1</sup> Loc. cit., p. 65.

<sup>2</sup> Journal of the American Medical Association, February 29, 1896.

<sup>3</sup> Loc. cit., p. 777.

<sup>4</sup> Annals of Surgery, January, 1894, p. 28.

Hawkins<sup>1</sup> found it fifty-seven times in sixty-one cases of general peritonitis or perityphlitis from disease of the appendix, and in fifty of these cases it was the only germ present. Park<sup>2</sup> found it in acute perforative, gangrenous, and recurrent forms of appendicitis. Ekehorn's<sup>3</sup> experiments demonstrated their pathogenic rôle in lower animals, besides showing that their virulence was not as great when derived from cases of recurrent and chronic appendicitis as when taken from acute and rapidly progressing cases.

A. Kelly,<sup>4</sup> pathologist to the German Hospital in Philadelphia, has lately published the results of bacteriological examinations of two hundred and one appendices, all removed during the year 1898, of which ninety-four were instances of acute appendicitis and one hundred and seven of chronic appendicitis. In the ninety-four cases of acute appendicitis, bacillus coli communis was found alone in sixty-nine (73.4 per cent.); bacillus coli communis and staphylococcus pyogenes aureus in thirteen (13.8 per cent.); bacillus pyocyaneus alone in six (6.4 per cent.); staphylococcus pyogenes albus alone in three (3.2 per cent.); bacillus coli communis and streptococcus pyogenes in one (1.05 per cent.); staphylococcus pyogenes aureus alone in one (1.05 per cent.); no growth in one (1.05 per cent.). In the one hundred and seven cases of chronic appendicitis he found bacillus coli communis alone in ninety-six (89.7 per cent.); bacillus coli communis and staphylococcus pyogenes aureus in five (4.7 per cent.); bacillus pyocyaneus alone in one (0.93 per cent.); staphylococcus pyogenes aureus alone in one (0.93 per cent.); bacillus

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<sup>1</sup> Loc. cit., pp. 71 and 72.

<sup>2</sup> Annals of Surgery, September, 1893.

<sup>3</sup> Bacterium Coli Communis en orsak till appendicit, Centralblatt für Med., 1893.

<sup>4</sup> Philadelphia Medical Journal, November 25, 1899.

coli communis and bacillus prodigiosus in one (0.93 per cent.); no growth in three (2.80 per cent.).

A pure culture of colon bacillus injected into a healthy peritoneal cavity acts, according to Ziegler,<sup>1</sup> in proportion to the amount injected. A small dose produces diarrhœa, followed by recovery; a somewhat larger dose produces localized purulent peritonitis; a still larger one produces a fatal, diffuse, fibro-purulent peritonitis, and, if very large, death from acute sepsis before peritonitis has time to develop. This shows that the peritoneum is able to overcome certain quantities of bacterial poison. Fowler<sup>2</sup> considers that this bacillus is in the majority of cases the cause of appendicitis. Treves<sup>3</sup> thinks two conditions necessary for the establishment of an appendicitis: such a condition in the bowel as will render the colon bacillus virulent and such a lesion in the appendix as will permit it to reach the peritoneum; the last condition, however, is not necessary, as it may start in the wall. Malvoz,<sup>4</sup> of Liège, concludes that bacterium coli communis plays a more important rôle than has been imagined, and that it particularly is one of the most frequent causes of peritonitis originating in the intestines, although it would perhaps be rash to assert that all cases of inflammation of the peritoneum which originate in the intestinal tube depend exclusively on the microbe. Surgeon-General Sternberg,<sup>5</sup> of the United States army, a well-known authority in bacteriology, says that bacillus coli is now known to be the usual cause of peritonitis.

There seems, therefore, little doubt that this bacillus may

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<sup>1</sup> Therapeutic Gazette, June, 1894, p. 29.

<sup>2</sup> Annals of Surgery, January, 1894, p. 31.

<sup>3</sup> British Medical Journal, March 9, 1895, p. 517.

<sup>4</sup> Le bacterium coli communis, Archives de Médecine expérimentale et d'Anatomie pathologique, 1891, p. 610.

<sup>5</sup> American Journal of the Medical Sciences, 1894, vol. cvii. p. 664.

become pyogenic under favorable circumstances, that it is usually present in appendicitis, and that the majority of cases thereof depend upon its entrance into the wall of the appendix. Its virulence may also, perhaps, depend to some extent on the medium in which it grows. It grows exceedingly well in the secretion from the appendix. Roger and Josué<sup>1</sup> ligated the appendix in a rabbit, avoiding the vessels. Three months later the appendix was transformed into a cyst on the distal side of the ligature, and the dilated part contained pus with colon bacilli. They concluded that the bacillus coli becomes virulent when the secretion, on account of stricture, is prevented from entering into the cæcum. That strictures are an important etiological element in the development of appendicitis, on account partly of the stagnation they produce and partly of the rapid growth of the colon bacillus in the retained secretion, will be shown later.

The colon bacillus is, however, not the only germ found. *Streptococcus pyogenes* has often been found alone in pus and exudates from peritonitis, particularly post-operative and puerperal peritonitis. *Staphylococcus aureus* and *staphylococcus albus* have also been found alone, but, as a rule, in those forms of appendicitis which result from a suppurating salpingitis.

Hawkins<sup>2</sup> believes that peritonitis resulting from infection from without, such as puerperal peritonitis, peritonitis after laparotomy, and peritonitis complicating pelvic diseases, depends upon streptococcus, often associated with staphylococcus, while peritonitis from perforation always depends upon the colon bacillus. We find, nevertheless, occasionally, these other germs in cases of pure appendicitis. Hodenpyl<sup>3</sup> found

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<sup>1</sup> Semaine Médicale, 1896, Nos. 7 and 8.

<sup>2</sup> Loc. cit., pp. 65 and 68.

<sup>3</sup> Loc. cit., p. 777.

the streptococcus present alone in one case; in another mixed with the colon bacillus.

Finkelstein<sup>1</sup> believes that the streptococcus and staphylococcus are the real pyogenic bacilli, and that the colon bacillus is comparatively harmless. He found the streptococcus twenty-eight times in forty-one cases. The bacillus coli, to be sure, was always found, as it belongs in the bowels. It grows very quickly and outstrips the other forms, and has, he thinks, for that reason been considered pathological. Microscopic examination of fresh pus also shows that the bacillus coli is less frequent than the pyogenic cocci.

Monod,<sup>2</sup> who reports the results of bacterial examinations from cases in his service in Saint-Antoine Hospital, found the pus from periappendicular abscesses generally very rich in microbes, the two most frequently found being bacillus coli communis and streptococcus. He also mentions Achard's results from bacterial examination of twenty cases. The colon bacillus was rarely found alone; generally it was associated with other microbes, most frequently with streptococcus, less frequently with staphylococcus, pneumococcus, and different saprophytes. He concludes that the colon bacillus is not the principal agent of infection, and that, although often found to predominate, it is because of its greater vitality and the facility with which it grows in cultures.

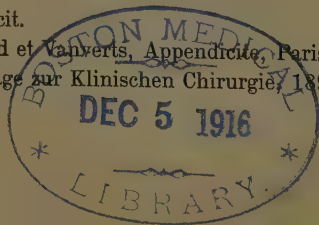
Czerny and Heddaeus,<sup>3</sup> on the other hand, consider the bacillus coli communis the cause of gangrenous inflammations with perforation and acute septic peritonitis. Streptococci, sometimes also staphylococci, produce, in their opinion, suppurative inflammations which originate either in the appendix or in its surroundings, and lead to abscesses, which are gen-

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<sup>1</sup> Loc. cit.

<sup>2</sup> Monod et Vanverts, *Appendicite*, Paris, 1897, p. 55.

<sup>3</sup> Beiträge zur Klinischen Chirurgie, 1898, Tübingen, Band xxi.





erally localized, but by perforation may produce acute suppurative peritonitis.

Veillon and Zuber,<sup>1</sup> again, do not believe that the colon bacillus and the streptococcus are the principal agents in gangrenous and perforative forms. They think that the fetid pus, the tendency to gangrene, and the symptoms of profound intoxication are due to anaërobic microbes, which are not well known but are constantly found in periappendicular abscesses.

All authors, however, agree that some forms of bacteria are the main cause of appendicitis, under favorable circumstances, such as strictures, coprolites, and all the other etiological factors mentioned. Bacterial infection may, however, occur without fecal concretions being present, just as ulceration, perforation, and gangrene may take place without the presence of coprolites.

Professor Cassaet<sup>2</sup> has called attention to still another germ, the pneumococcus, which occasionally may produce a very dangerous form of peritonitis, greatly resembling appendicitis. The pneumococcus enters through the skin or intestines after traumatism, or is conveyed by the blood or lymphatics, and produces effusion into the peritoneum, with a tendency to circumscribed purulent collections. The mortality, he states, is seventy-five per cent., unless laparotomy with thorough irrigation of the abdominal cavity is performed, which brings the mortality down to twenty per cent.

**Strictures, Kinks, and Mechanical Obstructions.**—Strictures are, as previously mentioned, a frequent cause of the development of appendicitis, on account partly of the stagnation they produce, partly of the rapid growth of microbes in the retained secretion.

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<sup>1</sup> Loc. cit.

<sup>2</sup> Archives Clin. de Bordeaux, reported in Journal of the American Medical Association, October 29, 1896, p. 490.

Professor Dieulafoy<sup>1</sup> considers them of the greatest importance, and believes that appendicitis is always the result of the conversion of the appendix into a closed cavity, the closure taking place at any point in its lumen, and being due either to the progressive formation of a calculus or to local infection, analogous to obliteration of the bile-duct in catarrhal icterus, or to cicatricial retraction and formation of a fibrous stricture, analogous to the formation of a urethral stricture. Cystic dilatation takes place on the distal side of the stricture, the germs normally present in the appendix multiply and become virulent, and appendicitis is the result. Symptoms of appendicitis occur first, he believes, when this cystic dilatation has appeared. We have no means of discovering before that time the existence of a process which will infallibly result, some day, in an attack of that formidable disease.

Sonnenburg<sup>2</sup> also mentions, as a result of ulcerative catarrhal inflammation, stricture by cicatricial retraction, torsion, or bending, which may produce stagnation and lead to acute processes.

Treves,<sup>3</sup> who has removed the appendix one hundred and fifty times in cases of relapsing appendicitis, says that "it would appear as if, in the majority of cases, the attack is due to distention of the appendix behind a stenosed or occluded point." He found the appendix stenosed and the distal part dilated in thirty per cent., bent upon itself and the distal part dilated and much ulcerated in fifteen per cent., constricted and bound down by adhesions and the distal part dilated and much ulcerated in eight per cent., twisted upon

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<sup>1</sup> Report of Proceedings of the Academy of Medicine in Paris, March 10, 1896, in Medical Record, March 14, 1896.

<sup>2</sup> Loc. cit., p. 167.

<sup>3</sup> Clifford Allbutt's System of Medicine, 1897, vol. iii. p. 921.

itself and the distal part dilated in four per cent., buried in a mass of dense adhesions and extensively diseased or partially destroyed in sixteen per cent., occupied by a concretion in fifteen per cent., little changed and exhibiting only the phenomena of ulceration in four per cent., and ulcerated and perforated with an abscess outside its wall in eight per cent.

White<sup>1</sup> believes that a mechanical obstruction may be the only exciting cause, although bacterial infection usually, perhaps constantly, comes into play.

Hawkins<sup>2</sup> states that strictures may be found at any spot, but generally near the cæcal end. In some cases two or more strictures may be found at different points, between which the lumen is dilated. In other cases of obstruction he found this due to kinking of the tube by an acute bend, independent of any inflammation. These forms are more apt to be followed by an extreme degree of cystic distention, as the mucous membrane is intact. Nevertheless, at the point of the bend a stricture is apt to form, making the cystic formation permanent.

Lennander,<sup>3</sup> who recognizes as primary cause the colon bacillus or other pathogenic bacteria, lays great stress on strictures and bends of the appendix, by which also the circulation is interfered with. The cæcum itself may produce more or less stasis by direct pressure on an appendix lying behind it in the retrocæcal fossa or buried in its wall.

Kümmell<sup>4</sup> considers appendices in which fecal matter is found almost without exception in a pathological state. Stasis occurs on account of the swelling of the mucous membrane

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<sup>1</sup> An Address on Appendicitis, *Therapeutic Gazette*, June 15, 1894.

<sup>2</sup> *Loc. cit.*, pp. 29 and 32.

<sup>3</sup> *Loc. cit.*, p. 19.

<sup>4</sup> *Berliner Klinische Wochenschrift*, April 11, 1898.

at Gerlach's valve, and this leads to further pathological changes. The organ becomes stiff, firm, and, so to speak, in a state of erection; the mucous membrane is swollen, the muscularis hypertrophied; strictures are present in the majority of cases, dependent upon ulcerations, and behind these strictures the appendix is dilated and the cavity filled with a thin, badly smelling fluid and elongated fecal masses.

That strictures are exceedingly frequent I have observed in my own cases, they being present in forty-three per cent. They have an important bearing on the question of perfect recovery after an attack of appendicitis. While I do not deny that complete recovery may occur in the early and mild forms so long as the swelling of the mucous membrane is the principal pathological lesion, I believe, nevertheless, that such a result will be an exception, or almost an impossibility, so soon as chronic catarrh or ulceration with succeeding stricture occurs, unless obliteration of the appendix takes place or it is destroyed by gangrene. There is no reason whatever for believing that strictures may become more easily absorbed here than in any other place. There is probably always infiltration of the submucous tissue where there is chronic catarrh or ulceration, and a stricture once formed will not merely continue to exist, but will also prevent perfect recovery and form a most important etiological factor in new attacks.

**Traumatism and Overeating.**—A direct injury occasionally precedes an attack of appendicitis. Fitz<sup>1</sup> found this the cause nineteen times in two hundred and fifty-seven cases; Hawkins,<sup>2</sup> sixteen times in one hundred and ninety cases; I, six times in one hundred and eighty-five cases. Hawkins mentions an indigestible meal as cause in twelve of one hundred

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<sup>1</sup> American Journal of the Medical Sciences, 1886.

<sup>2</sup> Loc. cit., p. 77.

and ninety cases, and thinks it possible that strong peristaltic movements were produced.

Hereditv is mentioned by Roux as an etiological factor in forty per cent. This seems enormously overstated. In my one hundred and eighty-five cases I have met heredity as an etiological factor but four times.

**Actinomycosis.**—Very few cases have been reported. Kelynack<sup>1</sup> thinks that there is but one case on record, reported by Dr. Ransom, of Nottingham, who suggests that probably a grain of corn, bearing the parasite, lodged within the appendix.

Lange,<sup>2</sup> however, reports the case of a man, twenty-one years of age, with a large swelling in the iliac region, supposed to be a cold abscess due to tuberculous osteitis of the ileum. It was by incision found to be actinomycosis, and at the bottom of the large wound lay the perforated appendix. Later an ulcer formed from the ascending colon, through which half of the fecal matter was discharged. The patient recovered after resection of the appendix and ascending colon. The appendix was found long, hypertrophied, and containing pus foci, but without any more elements of actinomycosis. Lange has seen about thirty cases of actinomycosis in various parts of the body, and considers it to be much more frequent than is usually supposed. During the last two years numerous cases have been reported, particularly in Germany.

## PATHOLOGY.

### FREQUENCY.

Appendicitis, in all its different forms, is of very frequent occurrence. Richardson<sup>3</sup> has examined the mortality-tables

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<sup>1</sup> Loc. cit., pp. 127 and 129.

<sup>2</sup> *Annals of Surgery*, September, 1896, p. 371.

<sup>3</sup> *American Journal of the Medical Sciences*, 1894.

from the time when only cases with local abscesses of several weeks' duration were submitted to operation, while cases of gangrene, perforation, and diffuse peritonitis were buried with the diagnosis "inflammation of the bowels." As a result of his investigations, he has come to the conclusion that appendicitis is the most important acute abdominal disease in our days and, with the exception of certain zymotic diseases, the cause of more deaths than any other abdominal affection. He is convinced that at least ninety per cent. of all deaths from inflammation of the bowels in young men are the result of appendicitis. Thus, in Boston during the five years 1880 to 1884, before we had commenced to operate for perforating appendicitis, two hundred and eighteen young men died of inflammation of the bowels, of which cases probably one hundred and ninety-four were the result of perforating appendicitis. Richardson concludes, from a personal experience with one hundred and eighty operative cases, that appendicitis, with very few exceptions, is the cause of all cases of local and diffuse peritonitis in young men.

It is of interest to compare these statistics with those of Copenhagen, in view of the facts that the opium treatment is still almost exclusively used there, and that almost all serious cases are treated in the two large civil hospitals. The mortality-tables, however, give two diagnoses: first, peritonitis extra-puerperium; and second, enteritis, colitis, and typhlitis, among which there may be hidden many cases of appendicitis.

There died in Copenhagen, however, according to the mortality-tables, during the years 1880 to 1884, of peritonitis extra-puerperium, one hundred and sixty-eight men and one hundred and fifty-five women; during the years 1885 to 1889, one hundred and forty-two men and one hundred and eighty-two women; during the years 1890 to 1894, one hundred and sixty-six men and two hundred and nine women; and during the years 1895 to 1898, one hundred



and nineteen men and one hundred and sixty-six women, showing that there die of peritonitis in Copenhagen as many individuals yearly in proportion to the population as in Boston before early operations were introduced. It is at least probable that the cause is the same,—appendicitis. I mention this fact because the opinion seems prevalent that appendicitis is more frequently found in America than anywhere else. Toft's<sup>1</sup> investigations also showed the frequency of appendicular lesions, as he found it diseased in thirty-six per cent. of all post-mortem examinations.

Hawkins<sup>2</sup> made similar investigations on one hundred bodies of all ages, where death occurred from some other cause than appendicitis, examining all suspicious cases microscopically. In sixteen of these one hundred cases there was evidence of past or present disease of the appendix. Seven of them had chronic catarrh, four had total or partial obliteration of the lumen, and five had ulceration due to pressure of a fecal mass. Hawkins concludes that there is ample evidence that appendicular disease is, at any rate, of frequent occurrence, and that we are justified in regarding the appendix as the sole cause of all cases of perityphlitis, mild or severe.

Ferguson<sup>3</sup> found in twenty autopsies evidence of previous affection in but seven cases, while fifteen cases contained, in addition to this, foreign bodies or scybala. It is not mentioned whether the microscope was used in these investigations. Talamon<sup>4</sup> concludes from different statistics that we meet appendicular lesions in twenty per cent. of all sub-

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<sup>1</sup> Om ulceration og perforation of Processus Vermiformis, Kjöbenhavn, 1868.

<sup>2</sup> Loc. cit., p. 23.

<sup>3</sup> American Journal of the Medical Sciences, 1891.

<sup>4</sup> Loc. cit., p. 29.

jects who have succumbed to divers affections. Wallis's<sup>1</sup> examinations from Sabbatsberg Hospital, in Stockholm, showed that death from appendicitis formed one and one-tenth per cent. of all fatal cases from 1879 to 1891, and occurred twice as often in males as in females. In males between the ages of ten and thirty years it formed four per cent. of all fatal cases.

### CLASSIFICATION.

The different forms of lesions in the appendix present certain characteristics in regard to the pathological condition, extent, severity, symptoms, etiology, etc., but, nevertheless, there is a perfect gradation from the mildest to the most severe and fatal cases. Any classification, therefore, is more or less artificial, as we frequently meet with cases which with equal right might belong to either one of two different subdivisions.

Osler,<sup>2</sup> for instance, divides appendicitis into catarrhal appendicitis and ulcerative appendicitis. In the catarrhal form the entire tube, but particularly the muscular coats, is thickened, the serosa congested, with slight adhesions, the lumen probably stenosed, with consecutive dilatation, and containing perhaps small fecal concretions. If cut open longitudinally, the appendix rolls up in the diverse direction. In the ulcerative form he expects to find fecal concretions, strictures, and partial obliterations, with ulcerations of different degrees, leading to circumscribed abscesses, diffuse peritonitis, or retrocæcal abscesses, according to the position of the appendix and the severity and suddenness of the attack. The question of bacterial infection—the most important of all—is left out. We find occasionally the most severe forms

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<sup>1</sup> Nordisk Medicinisk Arkiv, 1893, Band iii. Heft 2.

<sup>2</sup> Practice of Medicine, 1894, p. 407.

of sepsis in cases in which the appendix, macroscopically at least, is comparatively healthy, and in which the infection starts in the wall of the appendix and extends through a septic lymphangitis. Besides, the ulcerative forms, with abscess and peritonitis, although dependent upon ulcerations, are so different in regard to etiology, pathology, symptoms, and prognosis, that it scarcely seems proper to describe them all in one division.

Professor With's<sup>1</sup> classification (peritonitis appendicularis adhesiva, localis and universalis) is more appropriate, as he calls attention to the extreme importance of the affection of the peritoneum; but, on the other hand, appendicitis may be present without the peritoneum being affected and without ulceration being present. There is no place in his classification for chronic, recurrent, or infectious forms.

Hawkins<sup>2</sup> classifies his cases pathologically, in four groups:

1. Catarrhal appendicitis, marked particularly by shedding of the epithelium, and apt to pass into a chronic condition with thickening of the wall.
2. Cystic condition of appendix, due to a post-catarrhal stricture or kinking.
3. Ulcerative appendicitis, due to coprolites or foreign bodies.
4. Acute infective inflammation of the wall, due to bacilli, occurring either without much change in the mucous membrane or following one of the three former ones.

Clinically<sup>3</sup> he uses the same classification as Professor With,—adhesive peritonitis, perityphlitis with local abscess, and perityphlitis with general peritonitis,—although he acknowledges that there is no such absolute distinction in the

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<sup>1</sup> Festskrifter ved Kjöbenhavns Universitet, 1879, p. 59.

<sup>2</sup> Loc. cit., p. 55.

<sup>3</sup> Loc. cit., p. 75.

natural history of the disease. There is, he says, in regard to the extent of peritoneum inflamed, every degree between an absolute general peritonitis and one involving the surface of the appendix only, and, as regards the character of the exudation, every degree between an abdomen full of pus and a trace of coagulated fibrin on the floor of the right iliac fossa.

Murphy<sup>1</sup> gives probably the most specific pathological classification, taking regard both to the lesions of the appendix and to their effect upon the surrounding organs and peritoneum. He divides them into seven groups :

1. Simple catarrhal appendicitis, accompanying a catarrhal enteritis and without peculiar symptoms, except slight tenderness.
2. Ulceration of mucous membrane without perforation.
  - a. Pressure-atrophy with infection.
  - b. Ulceration with purulent accumulation.
  - c. Typhoid ulcer.
  - d. Tubercular ulcer.
3. Ulceration with perforation.
4. Gangrene of mucous membrane, dependent upon mechanical compression by foreign bodies, by accumulated fluid, or by infection of the wall.
  - a. Local.
  - b. General.
5. Gangrene of appendix complete, by compression of base by foreign body, by infection of the wall, or by contortion.
  - a. With perforation.
  - b. Without perforation.

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<sup>1</sup> Journal of the American Medical Association, March, 1894, and Medical News, January 5, 1895.

6. Infection of peritoneal cavity.
  - a. Without perforation, local or general.
  - b. With perforation, local or general.
7. Peritonitis.
  - a. Local peritonitis without limiting adhesions.
  - b. Circumscribed abscess.
  - c. General peritonitis.

His subdivisions are, however, carried too far. There is no difference between an ulceration and a local gangrene of the mucous membrane, either pathologically or etiologically; nor between ulceration with perforation (No. 3) and infection of the peritoneal cavity with perforation (No. 6). Peritonitis is simply a stage in the disease, and may result from any form, even from a simple catarrhal appendicitis, or may even occur without any particular macroscopical lesion of the appendix.

Berry<sup>1</sup> and Kelynack<sup>2</sup> give a classification that is clinically correct, but not sufficiently comprehensive pathologically. This classification is :

- A. Simple inflammatory forms, to which belong :
  1. The non-perforating or medical appendicitis, including mild forms that yield to medical treatment.
  2. The perforating or surgical appendicitis, which always demands surgical treatment.
  3. Recurrent or chronic appendicitis, also a surgical affection.
- B. Specific inflammatory appendicitis, with its subdivisions :
  - Tuberculous appendicitis.
  - Typhoid appendicitis.
  - Actinomycotic appendicitis.

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<sup>1</sup> Loc. cit.

<sup>2</sup> Loc. cit., p. 77.

It has no place for the more severe forms of simple appendicitis which are surgical lesions without being perforating forms, such as cystic dilatation from strictures and kinks, ulcerative forms from pressure-necrosis from coprolites, infectious forms terminating in total or partial gangrene or in septic lymphangitis, all dependent upon bacteria.

Sonnenburg,<sup>1</sup> who maintains (and I perfectly agree with him) that in the great majority of cases we are able to make an anatomical diagnosis, and to recognize clinically the different pathological processes, divides his cases into appendicitis simplex, perforativa, and gangrenosa. Appendicitis with localized abscess, however, is a perforative form, as is appendicitis with diffuse peritonitis, while appendicitis gangrenosa is simply the early stage of the latter. The chronic forms have no place in his classification. Czerny<sup>2</sup> classifies his cases clinically as, (1) acute perforation of the appendix; (2) subacute perityphlitic abscess, either from different pyogenic bacilli or from actinomycosis; and (3) simple chronic appendicitis, either from tuberculosis, ulcerating and obliterating forms, or from catarrhal inflammations. The first two divisions are perforating forms and both depend on pyogenic bacilli, while clinically he has no place for the catarrhal or the gangrenous forms, which are distinctly clinical.

I believe it more useful to classify the cases *pathologically* into

Simple catarrhal appendicitis,  
Ulcerative appendicitis,  
Infectious appendicitis.

I acknowledge that this classification is more or less artificial, that they encroach upon one another, that they all may

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<sup>1</sup> Mittheilungen aus den Grenzgebieten der Medicin und Chirurgie, 1898, Band iii. Ss. 1-21.

<sup>2</sup> Beiträge zur Klinischen Chirurgie (Tübingen), 1898, Band xxi.



be followed by the same complications, such as ulceration, gangrene, perforation with localized abscesses, diffuse peritonitis, etc., while the seriousness of the attack depends upon the amount of infectious material which enters the peritoneum. Nevertheless, each of these subdivisions is characterized by distinct pathological changes, each of them has a distinct form of peritonitis, each of them has its own prognosis and symptoms, and we may find place in them for any case. Clinically, however, it does not suit so well. Appendicitis with localized abscess, appendicitis with gangrene, and appendicitis with diffuse peritonitis are pathologically either ulcerative or infectious in form, but clinically there is an enormous difference between them. Clinically, I have, therefore, used the following classification :

Simple appendicitis,

Appendicitis with perforation and local circumscribed abscess,

Appendicitis with gangrene, without perforation,

Appendicitis with gangrene, perforation, and diffuse peritonitis, and

Chronic recurring appendicitis.

#### SIMPLE CATARRHAL APPENDICITIS.

This form is probably of frequent occurrence, although we have no means of establishing the frequency, as it usually gives no symptoms save a slight tenderness. It may subside without leaving any trace, if the cause be removed, but it is probable that it more frequently goes over into a subacute or chronic form, leaving pathological changes which favor new attacks.

The pathological changes<sup>1</sup> are those of any other inflammation of a mucous membrane,—shedding of the epithelium,

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<sup>1</sup> Hawkins, loc. cit., p. 24.

infiltration of the submucous tissue, and formation of granulation-tissue, which by cicatricial retraction may lead to partial or total obliteration, the latter being a perfect cure, so far as the appendicitis is concerned, and to the formation of strictures, which, again, are the principal cause of chronic appendicitis and the recurring attacks of acute appendicitis. Perfect recovery may occur if the process be mild and the epithelium be reproduced, or if total obliteration take place; but more frequently, probably, the process goes on. The lumen is found filled with leucocytes and a foul, badly smelling secretion; the swelling of the membrane near Gerlach's valve produces stagnation; the muscular coats become thickened and infiltrated, while pus is secreted from the new granulation-tissue. The microbes present multiply and become virulent, while their entrance into the wall is made easy by the destruction of the epithelium, and the more severe forms with gangrene and perforation very quickly develop,—so quickly that the acute inflammatory stage of the mucosa often may be completely overlooked.<sup>1</sup>

If neither spontaneous recovery by total obliteration nor death intervene, strictures are apt to result, or else pathological changes which act as strictures, such as kinks, bends, and stiffness of the organ from infiltration of the wall, leaving it, so to speak, in a state of erection. Lockwood<sup>2</sup> thinks the usual sequence of events, as shown by an examination of fifty-three specimens, to be as follows: destruction of the epithelial lining of the lumen, ulceration of the mucosa, bacterial invasion of the mucosa and submucosa, and extension of the inflammation to the peritoneum. This process may be complicated by the formation of cicatricial strictures, by inflammatory obliteration of the whole lumen after destruc-

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<sup>1</sup> Hawkins, loc. cit., p. 27.

<sup>2</sup> British Medical Journal, January 27, 1900.

tion of the mucosa, by the presence of fecal concretions, by perforation, by gangrene, by inflammation of the appendicular lymphatics, and by portal pyæmia. Hawkins<sup>1</sup> believes that strictures will form more easily at the insertion, although two or three strictures may be found at different points. Obstruction, he states, may also occur by an acute bend, in some cases the result of old adhesions, in other cases probably due to shrinking of an infiltrated mesenteriolum.<sup>2</sup> The higher degrees of cystic dilatation often accompany such bends, as the mucous membrane is comparatively intact and continues to secrete, for a time at least, until by the increased tension it becomes atrophied, or acute attacks supervene from bacterial infection. In course of time a permanent fibrous stricture is developed at the site of the bend in most cases, although by straightening of the tube the cystic dilatation may disappear. Treves<sup>3</sup> mentions such a case. I believe that perfect recovery may occur after the acute catarrhal forms, when the process recedes and the epithelium is re-established; I judge, however, from analogy with acute inflammations in other mucous membranes. There are no statistics of any value bearing on this point, and no post-mortem examinations; neither can such a mild attack be diagnosed clinically. Treves<sup>4</sup> also acknowledges that an attack of appendicitis may be brought about by changes in the appendix so slight as to be difficult of recognition. That perfect recovery, however, may occur by total obliteration is demonstrated.

**Obliteration.**—Ribbert<sup>5</sup> found obliteration of the appendix in twenty-five per cent. of four hundred autopsies, but warns

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<sup>1</sup> Loc. cit., p. 30.      <sup>2</sup> Treves, *Lancet*, February 18, 1888, p. 332.

<sup>3</sup> *Lancet*, February 9, 1889.

<sup>4</sup> *British Medical Journal*, October 31, 1896.

<sup>5</sup> *Virchow's Archiv für Pathologie, Anatomie und Physiologie*, 1893, S. 132.

against considering it always pathological, as the percentage increased with age, from four per cent. in children up to ten years to fifty per cent. in people over sixty years of age. Ribbert, therefore, believes it to be frequently a process of involution. He found total obliteration in sixteen cases. Finkelstein<sup>1</sup> also states that such a process is not necessarily pathological, but may be a phenomenon of involution. Kely-nack,<sup>2</sup> in ninety-eight cases, found the appendix partly obliterated, especially at its tip, in twenty-one and totally obliterated in two. Hawkins<sup>3</sup> found, in one hundred bodies, partial obliteration in four cases and total obliteration in one case. Renvers's<sup>4</sup> examinations are more convincing. He examined by autopsy thirteen patients, all of whom previously had recovered from attacks of appendicitis, and in every case but one found complete obliteration of the entire appendix, which was buried in adhesions. The serosa of the cæcum was thickened, the cæcum adherent instead of being freely movable. The appendix, buried in firm adhesions, was lying close to the cæcum, and could be recognized only by dissection. In one case he found a coprolite surrounded by fibrinous tissue. Fenger<sup>5</sup> considers it likely that partial or total obliteration may occur as the result of a mild attack.

Senn<sup>6</sup> mentions appendicitis obliterans as a quite frequent form and as characterized by progressive obliteration of the appendix. The process, he states, commences either as ulceration in the mucous membrane or as an interstitial inflammation, with destruction of the epithelium and the glands and formation of cicatricial tissue. While perfect obliteration

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<sup>1</sup> Deutsche Zeitschrift für Chirurgie, 1891, Band xxxviii.

<sup>2</sup> Loc. cit., p. 21.

<sup>3</sup> Loc. cit., p. 16.

<sup>4</sup> Zur Pathol. und Therap. der Perityphlitis, Deutsche Med. Wochenschrift, 1891, No. 5.

<sup>5</sup> American Journal of Obstetrics, 1893, vol. xxviii., No. 2.

<sup>6</sup> Journal of the American Medical Association, March 24, 1894.

tion may occur, it takes a long time, and danger is present meanwhile, as relapses take place with short intervals. He, therefore, considers operation to be indicated, and has performed it in four cases.

Perfect obliteration seems, however, according to the previous statistics, not to be of frequent occurrence, at least much less frequent than partial obliteration. This form, however, does not constitute a cure, but is (unless it happen to be in the tip) just as dangerous as a stricture, or rather more so, as it necessarily is followed by cystic development from stagnation of the secretion.

Morton<sup>1</sup> reports an operation on a man who for eight years had had repeated attacks of pain. The appendix was found obliterated in the inner third, while the two other thirds were dilated and contained a concretion one and a half inches long and an eighth of an inch in diameter. I have met total obliteration four times in sixty-six operations for chronic recurring appendicitis.

#### ULCERATIVE APPENDICITIS.

There is a perfect gradation from the catarrhal forms through cystic dilatation to the ulcerative forms. The cystic dilatation is the result of retained secretion on account of stricture, and the stricture, again, is the result of a preceding catarrhal appendicitis. These cystic dilatations change readily into empyema, on account of the growth and increased virulence of the microbes in the retained secretion. Their size depends upon the place of the stricture, their termination on the virulence of the microbes. That ulcerations form wherever pus is enclosed in a sac is evident and needs no demonstration. In my own statistics I find cystic dilatation, strictures, or bends as etiological factors in forty-three per

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<sup>1</sup> *Annals of Surgery*, September, 1896, p. 380.

cent. Professor Dieulafoy<sup>1</sup> considers cystic dilatation almost the rule, stating that in all cases of appendicitis there is partial obliteration of the appendicular canal, and that the appendix is converted into a closed cavity, either on account of a calculus, or from local infection, or from the formation of a stricture.

It is, however, a question whether mechanical obstruction alone is sufficient to produce ulceration, as White<sup>2</sup> and others have stated. MacDougall,<sup>3</sup> for instance, thinks that the possibility of appendicitis arising in a proportion of cases from mechanical causes cannot be overlooked. Its mobility, particularly, may favor strangulation. Hawkins<sup>4</sup> believes that this form depends upon a primary local ulceration due to the presence of a fecal concretion or foreign body, and not preceded by a general catarrh. I have no doubt that a sharp foreign body may produce ulceration by direct traumatism, and I have seen a few specimens in which perforation has occurred from foreign bodies. Fecal concretions, however, do not commence to increase in size until there is obstruction of the canal. In other words, the obstruction leads to the formation of fecal concretions, and a catarrhal condition precedes the obstruction in all cases. When the concrement increases in size and hardness by new deposits, atrophy may occur as a first result, followed later by necrosis from pressure, aided by muscular contractions to expel the concrement. The ulceration, however, is of particular importance as a gate of entrance of the microbes to the deeper tissues. The result is inflammation and suppuration with œdematous swelling, which may reach such a degree that the circulation is cut off and total gangrene occurs. In the majority of cases,

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<sup>1</sup> Loc. cit.

<sup>2</sup> Loc. cit.

<sup>3</sup> British Medical Journal, October 10, 1896.

<sup>4</sup> Loc. cit., p. 33.



however, the necrosis is localized, leading to perforation of the serosa, followed by either local or diffuse peritonitis. If the process is slow, a localized adhesive peritonitis has time to develop before perforation occurs. Exudation and agglutination of coils of intestine occur around the appendix, producing the usually felt tumor, and a local abscess forms, shut off from the peritoneal cavity by newly formed adhesions.

This abscess is primarily intraperitoneal, and may, according to Finkelstein,<sup>1</sup> be found in one of four different places: (1) Anteriorly and outward, the cæcum forming the posterior wall and agglutinated coils of intestines the inner wall; the parietal layer of the peritoneum forms the anterior wall when the abscess has become large. (2) Backward, with the posterior surface of the cæcum forming the anterior wall. This happens particularly in those cases in which the appendix lies wholly or partly behind the cæcum, or in which a septic lymphangitis (to be mentioned later) extends backward between the two layers of the mesenterium. The fascia transversalis limits the abscess anteriorly; the fascia iliaca, behind; upward it may extend behind the kidney, or even up to the liver, and produce a perinephritic or a subphrenic abscess. Downward it may, in rare cases, extend along the iliac vessels and appear on the anterior or inner surface of the femur, or perforate outward above the outer third of Poupart's ligament, or secondarily into the peritoneal cavity. (3) Inward, with the inner surface of the colon and cæcum as its external wall, the mesocolon as its posterior wall, and agglutinated coils of intestines forming its inner and lower wall. I consider this the most serious form and most difficult to operate upon without infecting the peritoneal cavity. (4) Downward into the pelvic cavity, with agglutinated coils as roof. All these abscesses may perhaps in rare cases be

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<sup>1</sup> Deutsche Zeitschrift für Chirurgie, 1891, Band xxxviii. S. 211.

reabsorbed spontaneously, but the usual course is gradual enlargement, and in favorable cases perforation into the cæcum, rectum, intestines, or bladder, resulting finally in a cure. The great danger is, however, secondary perforation into the abdominal cavity, producing diffuse peritonitis.

The appendix has now and then been found in inguinal and femoral ruptures on the right side. Both the appendix and the cæcum have been found in such cases very movable, on account of large mesenteriola. A regular appendicitis may develop in such cases, with symptoms more indicative of hernia than of appendicitis. Dr. Ludwig Kraft<sup>1</sup> examined the histories of five hundred and eighty-three cases of herniotomy from the Commune Hospital in Copenhagen. The appendix and ileum were found three times, the appendix and cæcum once, and the appendix alone four times. The appendix was present, therefore, in one and four-tenths per cent.

Gross<sup>2</sup> mentions a case of perforating appendicitis in an inguinal hernia, and Rotter<sup>3</sup> three cases of incarceration of the appendix in crural hernia in women and two cases in inguinal hernia in men. Edmund Owen<sup>4</sup> states that the appendix is not rarely found in inguinal hernia, and is generally accompanied by other portions of the bowel. It is exceptional to meet it in a femoral sac, and extremely rare to find it the sole occupant of such a sac. He reports, however, from St. Mary's and St. Thomas's Hospitals two cases of appendicitis in a femoral hernia.

Eccles<sup>5</sup> has collected twenty-nine cases, of which sixteen occurred in inguinal hernias and thirteen in femoral hernias. He thinks strangulation an exception, and believes the symp-

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<sup>1</sup> Appendix vermicularis i Brok, see Nordisk Medicinisk Arkiv, 1894, Heft 4.

<sup>2</sup> Deutsche Zeitschrift für Chirurgie, 1898.

<sup>3</sup> Über Perityphlitis, Berlin, 1899, S. 260.

<sup>4</sup> The Lancet, May 6, 1899.

<sup>5</sup> Ibid., May 20, 1899.

toms due to inflammatory conditions,—*i.e.*, to appendicitis occurring in the prolapsed appendix.

### INFECTIOUS APPENDICITIS.

While the ulcerative form of appendicitis generally has as predisposing cause a mechanical obstruction or fecal concrement, and perhaps may progress in rare cases to perforation without bacterial infection, the infectious form, on the other hand, depends upon bacterial infection as an exciting cause. It may start very suddenly, with violent pain and rapid fatal peritonitis, and, nevertheless, no necrosis and no perforation be visible to the naked eye,<sup>1</sup> or it may result from either the catarrhal or the ulcerative form and speedily lead to necrosis and perforation. We find all kinds and degrees of inflammation, from a simple catarrhal form, perhaps with loss of the epithelium only, to total gangrene of the whole appendix; but the mucous membrane may be intact and the inflammation start in the deeper tissues of the wall, producing necrosis of the submucous and muscular coats, or suppuration, or, lastly, infiltration and exudation.<sup>2</sup> All three forms are alike followed by virulent peritonitis, and bacteria are found in the muscular and submucous coats in them all, as well as in the peritoneal exudate around the diseased appendix, even if there is no perforation of the wall. The very fact that the inflammation may start in the wall is suggestive of the action of some agent which has penetrated from without; violent inflammations besides, leading to necrosis or gangrene, are invariably of bacterial origin.

MacDougall<sup>3</sup> says that the greatest interest is attached to the infectious form. When we recognize that "it may occur independently of the presence of a stercolith, of a foreign body,

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<sup>1</sup> Hawkins, *loc. cit.*, p. 39.

<sup>2</sup> *Ibid.*, *loc. cit.*, p. 45.

<sup>3</sup> British Medical Journal, October 10, 1896.

of severe ulceration, or of acute catarrh ; that it may produce at times, with little vital signs, gangrene of the appendix ; that it may give rise to an intense septic peritonitis without visible perforative lesions of the parietal wall ; and that it is a common cause of acute general peritonitis, we can realize how insidious may be its origin, and how widespread and evil its results."

Hawkins<sup>1</sup> thinks that the necrosis results from the direct action of the bacilli or their toxines upon the tissues, or from strangulation of the capillaries, analagous to sloughing of the skin from a tense œdema. Wyeth<sup>2</sup> thinks it due more to disturbance of the circulation from pressure or hyperdistention, as the process may go on so rapidly that total gangrene may be present in twelve hours, and before adhesions have time to form. Fowler<sup>3</sup> thinks it possible that an endarteritis or phlebitis may be the leading factor, particularly as there is but one artery. He found in one case a stasis thrombosis of septic origin. The gangrene, however, is always of the moist variety, and this would speak more for the interference with the vein than with the artery.

It has been mentioned that cases of diffuse peritonitis may occur without appreciable macroscopical lesion of the appendix, and even that death may take place before peritonitis has had time to develop. These cases have given rise to considerable discussion. Lennander<sup>4</sup> lays a good deal of stress on the lymphatic vessels, as Iversen<sup>5</sup> had done. The swelling of the mucous membrane and the increased secretion may produce a complete stenosis of the appendix in acute attacks, and the lymphatics may then offer

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<sup>1</sup> Loc. cit., p. 55.

<sup>2</sup> Loc. cit.

<sup>3</sup> Annals of Surgery, January, 1894, p. 19.

<sup>4</sup> Loc. cit., p. 21.

<sup>5</sup> Forhandlinger of Kjöbenhavn's Med. Selskab, Januar, 1891.

the only chance of removal of inflammatory products. The lymphatics follow the vasa ileocolica, along which numerous lymphatic glands normally are found. Lennander found these glands swollen in five cases of chronic appendicitis, and he considers it probable that acute lymphadenitis and lymphangitis also occur in the acute forms. Such a condition would account for the somnolence, profuse perspiration, and general malaise which often precede the attack and which may result from toxine poisoning through the lymphatics. In the same way, he thinks, we may explain those rare cases which begin with severe pain, meteorism, collapse, and all the symptoms of an acute appendicitis, and in which we by operation find neither peritonitis nor affection of the appendix serious enough to explain the condition. I have met at least three such cases. We may in such cases during early operation find nothing to explain the condition, while if we wait septic peritonitis may take place. Kümmell<sup>1</sup> also mentions that diffuse peritonitis may occur without perforation, and dependent upon a lymphangitis.

Lennander calls attention to another point of interest. Chronic appendicitis, he states, may probably occasion chronic lymphadenitis, and this may continue for a time after the removal of the appendix, so that perfect recovery may not take place immediately. Willy Meyer<sup>2</sup> also mentions a case as proof that acute sepsis with general peritonitis may set in without any macroscopical lesion of the appendix, although all clinical symptoms of perforation are present. Professor Dieulafoy<sup>3</sup> states that the virulence of the infection may suffice to kill the patient while the peritoneal symptoms are quite subsidiary, and that the infection may spread to the

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<sup>1</sup> Berliner Klinische Wochenschrift, April 11, 1898.

<sup>2</sup> Medical Record, February 29, 1896.

<sup>3</sup> Report of the Academy of Medicine, Paris, March 10, 1896.

peritoneum despite the absence of any perforation of the appendix, and any variety of peritonitis may be developed. He distinguishes, however, between the infectious and toxic effect of an appendicitis, and tries to prove it experimentally.<sup>1</sup> He maintains, as is well known, that the appendix becomes changed into a closed sac by the coprolite, and that the bacilli then increase in virulence and become pathogenic. A culture on bouillon from such a closed sac rapidly killed guinea-pigs by infection; while, on the other hand, six guinea-pigs died from toxæmia by inoculation with the filtered culture. A culture taken from the fluid of the appendix on the proximal side of the stricture had neither an infectious nor a toxic effect. Fenger<sup>2</sup> mentions particularly one case of septic lymphangitis in which he found diffused islands of leucocytes or miliary microscopic abscesses in the subserosa. He believes the lymphangitis and diffuse inflammation more pronounced in the subperitoneal tissue than in the muscular coat, and that plastic peritonitis, therefore, is an almost constant consequence, and accounts for the adhesions in which the appendix afterwards is found buried. Murphy<sup>3</sup> mentions infection of the peritoneum through the wall of the appendix or along its mesentery, with general peritonitis, without perforation. Hawkins<sup>4</sup> considers it possible for a patient to die from infective appendicitis before necrosis of the wall has occurred, and that, on the other hand, in a case of general peritonitis the appendix may be examined during an explorative laparotomy and acquitted, while it, nevertheless, is the cause of the mischief. Such a septic lymphangitis and lymphadenitis may give rise to a

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<sup>1</sup> Deutsche Med. Wochenschrift, Vereinsbeilage vi., January 5, 1899.

<sup>2</sup> American Journal of Obstetrics, 1893, vol. xxviii., No. 2.

<sup>3</sup> Journal of the American Medical Association, March, 1894.

<sup>4</sup> Loc. cit., pp. 39 and 68.



primary retroperitoneal abscess, the inflammation spreading between the two layers of the mesentery backward, particularly in cases in which the mesentery covers the appendix out to the tip. Kórté<sup>1</sup> mentions this extension between the layers of the mesentery and has demonstrated it experimentally. Through a canula introduced into the mesentery of the appendix he was able to force colored fluid between the two layers of the mesentery into the retroperitoneal tissue and up behind the liver.

Ferguson's<sup>2</sup> and Turner's<sup>3</sup> examinations showed that the appendix in relatively thirty-eight and twenty-six per cent. lies behind the cæcum and in intimate connection with the retroperitoneal tissue. In such cases the inflammation will necessarily be in the line of a primary phlegmon in the subperitoneal tissue; otherwise, all other abscesses are, primarily at least, intraperitoneal.

As a final *résumé* I repeat the different stages through which, in my opinion, an appendicitis passes or may pass:

1. Catarrhal appendicitis.
2. Loss of the epithelium, with hypertrophy of the submucous layer, formation of granulation-tissue, and stenosis of the caliber.
3. Stricture.
4. Stagnation, dilatation, concretions, hydrops, and ulceration.
5. Bacterial infection, empyema, gangrene, perforation, abscess, or peritonitis.

Stricture or similar pathological changes form the cornerstone in the pathology, lead to stagnation and ulceration, and

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<sup>1</sup> Ueber Chirurgische Behandlung des Perityphlitis, Berliner Klin. Wochenschrift, 1891, Ss. 26 and 27.

<sup>2</sup> American Journal of the Medical Sciences, 1891.

<sup>3</sup> Quoted by Fowler, Annals of Surgery, May, 1894.

bacterial infection usually follows; but I acknowledge that bacterial infection may occur without stricture or ulceration, as a septic lymphangitis. I do not believe that every case of appendicitis necessarily is infectious! We may, for instance, have purely traumatic forms. I have laid more stress on the mechanical obstruction than is usual, and I do not consider strictures with dilatation, coprolites, hydrops, and ulceration, or the obliterating forms, necessarily infectious, even though the microbes at a certain point of time during their formation have played a rôle. Let infection be added, and we get immediately the gangrenous, perforating, and septic forms. That every case in which there is pus present is infectious is self-evident, but we meet numerous cases of appendicitis in which there is no pus.

#### THE PERITONEAL LESIONS.

There is no appendicitis, except in the very early forms, without more or less periappendicitis, which is simply another word for peritonitis; we may probably even go one step farther, and state that it is the affection of the peritoneum that produces the pain and swelling and makes the diagnosis clear. Talamon<sup>1</sup> distinguishes three forms, under which all forms may be classified: (1) fibrinoplastic peritonitis, or simple adhesive peritonitis; (2) fibrinopurulent peritonitis, the usual circumscribed perityphlitic abscess; and (3) seropurulent or serosanguinolent peritonitis, also called septic or acute diffuse peritonitis.

**Fibrinoplastic or Adhesive Peritonitis.**—This variety is found in the simple catarrhal or cystic forms, and may be regarded more as a beneficial process of nature than as a disease. Talamon<sup>2</sup> rightly compares it to the fibrinous pleurisy which takes place in contact with a focus of pneumonia. It may at the end of from thirty-six to forty-eight hours be

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<sup>1</sup> Loc. cit., p. 53.

<sup>2</sup> Loc. cit., p. 53.

sufficiently marked to produce adhesions between the appendix and the neighboring parts and to glue together coils of intestines.

Suppuration does not take place unless perforation of the appendix occurs; nevertheless, the colon bacillus has been found in the exudate. I have already stated that Bristow<sup>1</sup> got a pure culture from fresh exudations of lymph from the outer side of the appendix, as well as from the wall itself, or from peritoneal exudations and abscesses; and also that Ziegler's<sup>2</sup> experiments showed that a moderate amount of a pure culture of the colon bacillus injected into the peritoneal cavity would produce localized peritonitis only. I believe, therefore, that it is the same process and dependent upon the same cause—the colon bacillus—as in the more severe forms, but that the bacillus is present in small numbers and that the exciting cause, the simple catarrh or cystic degeneration, is less apt to produce ulcerations. Hawkins<sup>3</sup> in twenty-five such cases found chronic catarrh in fourteen, a cystic condition in seven, and a coprolite without ulceration in four. The exudation generally becomes absorbed again: it may, however, form adhesions and lead to obstruction. It may perhaps also lead to a circumscribed abscess, if pyogenic microbes perforate the wall of the appendix without causing ulceration.

*Obstruction* has usually been found dependent upon adhesions of the appendix to the neighboring parts, forming a loop, through which some portion of the intestines, generally the lower end of the ileum, has been strangulated. Kelynack<sup>4</sup> mentions a number of such cases from different authors. I have met with two cases. Obstruction, however, is more apt to form after the suppurative cases. Lange<sup>5</sup> operated on

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<sup>1</sup> Loc. cit.

<sup>2</sup> Loc. cit., p. 29.

<sup>3</sup> Loc. cit., p. 61.

<sup>4</sup> Loc. cit., p. 49.

<sup>5</sup> Annals of Surgery, September, 1886, p. 376.

one patient, twenty-two years of age, for ileus, four weeks after extensive suppurative peritonitis from appendicitis. He had formerly had six similar cases, of which three recovered. In the case mentioned a thick vascular band, constricting the ileum, extended from the mesentery to the mesocolon ascendens. He emphasizes the importance of a timely operation. McBurney<sup>1</sup> reports a case of volvulus occurring ten days after operation for appendicitis, with gangrene and perforation, and dependent upon adhesions of a coil of the ileum, producing a half-twist. The patient recovered by operation with loosening of the adhesions. In my case the sigmoid flexure was strongly adherent in the right ileocæcal region. The patient recovered by laparotomy with loosening of all the adhesions.

**Fibrinopurulent Peritonitis, or Circumscribed Abscess.**

—This form of peritonitis belongs particularly to ulcerative appendicitis, and depends upon the presence of a stricture or a fecal concretion, although it may follow a simple acute or chronic catarrh or a cystic dilatation, provided ulceration of the wall take place from some cause or another, so that bacteria may enter the wall. Hawkins,<sup>2</sup> in twenty-seven cases, found ten due to chronic catarrh with necrosis of the wall, fifteen to ulceration from a concretion, one to chronic catarrh without necrosis, and one to cystic dilatation. The abscess; as already mentioned, may be found in different places, according to the position of the appendix. It is always primarily intraperitoneal except in the cases in which the appendix is found wholly or partly behind the cæcum or in which the abscess depends upon a septic lymphangitis and starts in the retroperitoneal tissue. It may perforate into the different abdominal organs,—cæcum, rectum, ileum, bladder, etc.,—or through the abdominal wall or into the vagina.

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<sup>1</sup> Medical Record, July 25, 1896.

<sup>2</sup> Loc. cit., p. 60.

The most dangerous eventuality, however, is perforation into the abdominal cavity.

The pus is rarely *pus bonum et laudabile*. More frequently we find a seropurulent or serofecal, stinking fluid, mixed with fibrinous membranes and gangrenous particles, besides fecal matter, coprolites, and air. This depends upon whether or not there is a stricture of the appendix present on its proximal side. In the latter case we have a direct communication between the intestines and the abscess.

The size of the abscess depends upon the duration of the disease. I have in one case, in which the abscess was retro-cæcal and had been overlooked four weeks, seen it occupy the whole retroperitoneal tissue behind the kidney and up to the liver, and contain over one quart of pus. It may be divided into different parts extending in different directions. In one case I found a perfect hour-glass-shaped abscess, one half intraperitoneal and containing a fecal concrement, the other half retroperitoneal. The omentum in the neighborhood is often thickened, infiltrated, and adherent, forming some part of the wall. The veins may be affected by septic phlebitis and fatal pylephlebitis may result, or the septic phlebitis may start in the veins of the mesentery.

**Seropurulent or Serosanguinolent Peritonitis; Septic Diffuse Peritonitis.**—This is the most important form, on account of its acute onset and its almost invariably fatal termination unless operated on very early. It is characterized<sup>1</sup> by the absence of adhesions and the presence of a copious, thin exudation and stinking pus, together with a congested peritoneum, covered here and there with easily loosened fibrinous membranes. It occurs as the result of a perforation of the intestinal canal or of a circumscribed abscess. It is the common form of peritonitis with collapse, vomiting, con-

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<sup>1</sup> Barthold Carlson, *Hygieia*, November, 1898.

stipation, meteorism, high fever, small quick pulse, rapid respiration, and pain and board-like tension in the abdomen, and may be amenable to surgical treatment. It may result from any form of appendicitis, but it often starts as a first attack in apparently healthy appendices.<sup>1</sup> Sonnenburg,<sup>2</sup> in two hundred and ten patients, operated one hundred and fifty times (71.4 per cent.) during the first attack. Of my forty-seven cases twenty-six had never had a previous attack; nevertheless, in forty-two of these forty-seven cases the causal element was found to be coprolites twenty-two times, cystic dilatation seven times, and stricture thirteen times, numbers sufficient to show that pathological processes had been going on in these cases, although they had given no appreciable symptoms. Hawkins<sup>3</sup> in twenty-seven fatal cases found coprolites eleven times and cystic formations three times. It may, nevertheless, start without any ulceration in the mucous membrane, from either concretion or cystic dilatation, the inflammation in these cases being due to bacterial infection of the wall, probably preceded by an acute catarrh, and usually running a very acute course through septic lymphangitis.

Kelynack<sup>4</sup> distinguishes two pathological stages, gangrenous appendicitis and perforative appendicitis. During the gangrenous stage the wall is undergoing more or less necrosis, or it may even be totally gangrenous but yet without perforation. Kelynack thinks it may last from one to three days, but occasionally longer, and that it is characterized by very severe pains in the right iliac region. Thirty-four of my cases were of this form, with more or less total gangrene but without perforation. Thirty-two recovered by early operation and

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<sup>1</sup> Talamon, loc. cit., p. 56.

<sup>2</sup> Centralblatt für Chirurgie, July 16, 1898.

<sup>3</sup> Loc. cit., p. 58.

<sup>4</sup> Loc. cit., p. 93.



two died, one eight days after the operation, from hemorrhage from a mesenteric vein, and one on the third day after the operation, from pylephlebitis suppurativa. These thirty-four cases form, in my opinion, by all odds the most important part of the statistics as proving the extreme value of early operation. In those cases with very diffuse pains in the beginning we often meet a serous or serofibrinous exudation on opening the abdominal cavity. Roux<sup>1</sup> mentions the same exudation into the peritoneum in cases of circumscribed intra-peritoneal abscesses, and considers it simply symptomatic of the healthy peritoneum's reaction to an incapsulated abscess. It recedes if the abscess is opened or the gangrenous appendix extirpated, but forms an excellent medium for propagation and spreading of microbes if perforation occurs. Sonnenburg<sup>2</sup> also considers it as a reaction of the healthy serosa. It is generally perfectly sterile, and may be reabsorbed or form more or less firm adhesions. It may be present in so small a quantity as scarcely to be detected. It gives symptoms of peritoneal irritation with increased tension and tenderness, particularly in the left side. If perforation occur, however, it helps to spread the infection over the whole peritoneal cavity. It is similar to the exudation we meet in tunica vaginalis communis in cases of strangulated ruptures. The perforative stage is characterized by intense pain, sudden onset, and symptoms of diffuse peritonitis.

The peritonitis may result from primary perforation of a gangrenous appendix, particularly when a large amount of infectious material suddenly enters the peritoneal cavity or a smaller amount is carried over the whole peritoneal cavity

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<sup>1</sup> Du traitement chirurgical de la pérityphlite suppuré, *Revue Médicale de la Suisse Romande*, September 20, 1891.

<sup>2</sup> Mittheilungen aus den Grenzgebieten der Medicin und Chirurgie, 1898, Band iii.

by a previously developed serous exudation.<sup>1</sup> It may terminate fatally in a short time and give the clinical picture of peritoneal sepsis. Peritonitis frequently results from a large perforation of the appendix or from a secondary perforation of a localized abscess, the extent and character of the exudation being dependent upon the contents of the localized abscess. To show the relative frequency of perforation from appendicitis compared with perforation from other causes, Finkelstein<sup>2</sup> mentions Bouness's reports of fifty-nine cases of peritonitis from perforation, of which sixteen were from typhoid fever, eleven from appendicitis, nine from ulcer of the stomach, and seven from tubercular ulcers of the stomach, and Grawitz's report of five hundred and sixty cases, also showing that next after perforation from typhoid ulcers perforation from appendicitis is most frequent. Kelynack<sup>3</sup> thinks the primary perforation most frequent. Finkelstein, Kammerer, and others consider the secondary the most common, as most cases are chronic and give time for the formation of adhesions. I agree perfectly with Kelynack, as, of my forty-seven cases of gangrene with perforation and diffuse peritonitis, only one case was the result of secondary perforation of a circumscribed abscess; but I operate on my patients early and do not wait for a large abscess to form.

That the secondary perforations, as Finkelstein states, are the most malignant, because a large amount of infectious material is suddenly introduced into the peritoneal cavity, we may also agree to. The degree of peritoneal inflammation is proportionate to the infection, and depends probably upon the size of the perforation and the amount and virulence of the material introduced into the peritoneal cavity. The amount is often very small when a stricture is present on the proximal side of the perforation. If the amount is large the

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<sup>1</sup> Sonnenburg, *loc. cit.*<sup>2</sup> *Loc. cit.*, p. 220.<sup>3</sup> *Loc. cit.*, p. 93.

patient may die of shock or peritoneal sepsis in less than twenty-four hours, and we may find but a small amount of serosanguinolent fluid, or it may even be absent, as it has no time to develop. Sonnenburg<sup>1</sup> considers *peritoneal sepsis* a special form of peritonitis, and the most serious one, as, on account of its quick course, it may be unaccompanied by exudation. Many a case of death occurring a short time after laparotomy, and ascribed to heart-failure, is, in his opinion, the result of peritoneal sepsis, even when very few symptoms of peritonitis are found at the autopsy. Peritoneal sepsis is characterized by paralysis of the intestines, which produces decomposition of their contents and, by the aid of toxines and microbes passing through the wall, the fatal intoxication. The clinical diagnosis depends more upon the severe general symptoms than upon the local symptoms. The pulse is small, the respiration weak, the skin icteric, and the perspiration clammy, while the local symptoms may be insignificant, consisting principally of tenderness, particularly on the left side.

Barthold Carlson<sup>2</sup> also mentions acute peritoneal sepsis as characterized by absence of exudation and by enormous development of micro-organisms in the abdominal cavity. Clinically it presents the picture of an intoxication commencing without severe pains, but with cerebral symptoms, delirium, somnolence, and coma. It is caused by inflammations without perforation, and particularly by infection during laparotomy. It is fatal, with or without operation. As there is no exudation, an operation can neither relieve tension, evacuate pus and toxines, nor drain the cavity.

As a rule, however, we find agglutinations of the intensely congested intestines with false membranes, infiltrated with pus, and a turbid fluid with fibrinous flakes. If direct com-

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<sup>1</sup> Loc. cit.

<sup>2</sup> Hygieia, November, 1898.

munication with the cæcum be present, the exudation may have a fetid, stinking odor, and be sometimes mixed with gas and fecal particles. The colon bacillus is always present.<sup>1</sup> Walthard<sup>2</sup> concludes, from his experiments with purulent peritonitis, that it never occurs after an aseptic laparotomy, and that it is always due to infection with microbes. Mikulicz<sup>3</sup> mentions as special forms of appendicitis the acute septic peritonitis without exudation and with slight infection of the apparently normal peritoneum (Sonnenburg's peritoneal sepsis), the subacute peritonitis with dry, fibrinous adhesions but also without exudation, and the diffuse peritonitis with seropurulent or serofecal exudation according as we find perforation without or with free communication with the cæcum.

Fenger<sup>4</sup> considers the dry forms absolutely fatal; Morris<sup>5</sup> thinks that even they may occasionally recover by loosening of all adhesions and thorough disinfection. Mikulicz<sup>6</sup> mentions another special form, which he calls progressive fibropurulent peritonitis, in the beginning limited to the surroundings of the perforation, but later having limited pus foci between the agglutinated bowels. Every intraperitoneal pus focus must be opened by itself, and laparotomy is not indicated. He incised in one case six intraperitoneal abscesses at different times when fluctuation occurred; in another case three abscesses in the same way.

Sonnenburg<sup>7</sup> states that this form is generally benign and dependent upon the entrance of only small amounts of infectious material of a less virulent character. He recognizes two forms: one in which the abscesses are in direct

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<sup>1</sup> Talamon, loc. cit., p. 56.

<sup>2</sup> Deutsche Med. Zeitung.

<sup>3</sup> Archiv für Klin. Chirurgie, 1889, Band xxxix. S. 756.

<sup>4</sup> American Journal of Obstetrics, 1893, vol. xxviii., No. 2, p. 15.

<sup>5</sup> Lectures on Appendicitis, New York, 1895, p. 63.

<sup>6</sup> Annals of Surgery, 1889.

<sup>7</sup> Loc. cit.

communication with one another, while the rest of the peritoneum is healthy; and another in which the intestines are soldered together by fine adhesions, and contain between the coils many localized abscesses which do not communicate at all. This last form takes a chronic course, and may heal spontaneously. The diagnosis is difficult on account of the lack of characteristic symptoms. Mikulicz thinks that certain anatomical conditions help to localize these abscesses and prevent the diffuse peritonitis.

The transverse colon and the large omentum divide the peritoneal cavity into a supraomental space and an infraomental space. The infraomental space is again divided by the mesenterium of the jejunum and ileum into a supramesenteric portion and an inframesenteric portion. The supraomental space is divided by the liver into the subphrenic and the infrahepatic space. All barriers extend transversely, and oppose, therefore, extension of a suppuration in the vertical line upward, while pus may flow downward on account of its own gravity. On the lateral side of the ascending and descending colon there are no barriers to prevent the extension of a suppuration upward in a vertical line.

Treves<sup>1</sup> considers all forms of peritonitis septic and due to micro-organisms. He doubts that there is such a thing as rheumatic peritonitis, and is sure that there is no such thing as idiopathic peritonitis. "The constitutional symptoms of peritonitis are the same as those of septicæmia, and the patient dies from blood-poisoning and not from inflammation." One cannot help wondering why Treves, after such an acknowledgment, continues to delay operations and treat the disease as an inflammation.

I believe that the form of peritonitis generally depends upon whether there is a large perforation communicating

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<sup>1</sup> British Medical Journal, October 31, 1896.

freely with the cæcum, or simply a small perforation on the distal side of the stricture. In the first case we shall always, when adhesions are absent or insufficient, meet a rapidly fatal, diffuse peritonitis; in the second, a more slowly progressing and more favorable fibropurulent peritonitis. The secondary perforations are rarely seen in our days, at least in America, where we operate before such an eventuality can occur.

I have not mentioned **chronic recurring appendicitis** as a special pathological form, because I look upon it simply as a result of the catarrhal or of the ulcerative forms, dependent upon strictures, cystic dilatations, kinks and adhesions, and now and then coprolites. Sautham<sup>1</sup> reports the pathological condition in twenty cases of recurrent appendicitis treated by operation. In all the specimens examined there were evidences of chronic inflammatory changes, with thickening of the coats. In some cases the lumen was uniformly narrowed and almost obliterated, in others partially or completely occluded at some point and dilated on the distal side of the obstruction, with the formation of a cystic cavity. In many instances the appendix was considerably shortened, bent upon itself, or bound down by adhesions. The contents consisted either of clear mucus or of a mucopurulent fluid. In two cases a hard fecal concretion was present in the interior, and in a third a concretion had ulcerated through the wall and was found in an abscess cavity. Adhesive peritonitis was in most cases present, the inflammatory exudation having undergone organization and formed adhesions which were often very firm and extensive, surrounding the appendix and fixing it to the parietal peritoneum, omentum, cæcum, and small intestines. In some cases these changes were present after the second attack, in others absent after many

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<sup>1</sup> The Lancet, June 5, 1897.



attacks. When dense and extensive, complete obstruction of the bowels may be produced by inclusion and compression of a small coil of the intestines in the adhesions. Pus was found in the neighborhood of the appendix in eight cases,—localized in six and diffuse in two. The duration of the symptoms ranged from four months to six years, and the number of attacks from two to ten or more. A cure may occur ultimately by a gradual process of obliteration; supuration may, however, take place at any time. Tscherning<sup>1</sup> found in nineteen cases, operated on in the interval, similar pathological changes. Clinically, however, chronic recurring appendicitis is of great importance, as it may keep a patient in a state of chronic invalidism, although there is no great tendency to perforation. I have no doubt that numerous patients are treated for so-called *nervous dyspepsia* who simply suffer from a chronic recurring or obliterating form of appendicitis. I have seen and operated on a number of such cases, with the result that they recovered perfectly after the diseased appendix was removed. I will mention one of these cases by way of illustration. Mr. A., a young lawyer twenty-seven years of age, had for four years suffered from severe cardialgia, eructations, and dyspeptic phenomena. He had lost forty pounds in weight and looked pale and anæmic. The contents of his stomach had frequently been examined with negative result, and a diagnosis of nervous dyspepsia made. He had spent one year in New Mexico, going around on horseback in order to use the healing power of nature, and one year in Europe for recreation and to endeavor to forget his sufferings. He had visited different baths both in Europe and in America, lived for months on a milk diet, made long sea-voyages, had his stomach washed out, etc. He had consulted the most distinguished specialists both in America and

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<sup>1</sup> Hospitalstidenden, May 3, 1899.

Europe, and the diagnosis of nervous dyspepsia was made by them all. He consulted me a couple of years ago on passing through Buffalo. On examination I found a hard, tender, and swollen appendix, pressure on which produced vomiting and cardialgia. He had never, to his knowledge, had appendicitis, and was much astonished when I told him that he undoubtedly suffered from chronic appendicitis, and would recover only by its removal. I removed the appendix shortly after, and found it seven inches long and buried in old, dense adhesions. It contained a total stricture or obliteration one inch long, and on its distal side a dilatation with a coprolite. The operation produced a violent attack of cardialgia lasting some days. He rapidly improved thereafter, gained forty pounds during the next six weeks, and has been well since. Having since seen and operated on a number of similar cases with prompt and perfect result, I have been led to consider the diagnosis nervous dyspepsia with a good deal of scepticism.

Sonnenburg<sup>1</sup> does not wonder that in cases of chronic appendicitis we meet with symptoms which point to troubles in the stomach and intestines, as the nerves are intimately connected. When symptoms of irritation of the stomach and intestines occur with digestive disturbances, and we can find no cause for them on examination of these organs, we are warranted in suspecting that they are reflective in character, and due to an inflammatory focus somewhere in the abdominal cavity, preferably in the appendix. Many of these cases are considered nervous or hysterical in character, but a great number of them are undoubtedly indicative of a slowly progressing inflammation of the appendix. The symptoms may consist of an inclination to constipation, and slight diarrhoea with colic, frequently without any apparent

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<sup>1</sup> Loc. cit., p. 7.

cause. In other cases we meet functional disturbances of the heart and circulation. A careful examination in such cases, particularly when the disturbances recur repeatedly, will frequently reveal a tenderness in the ileocæcal region, and the patient may then remember that he has had most intense and frequent pains there.

Hayem,<sup>1</sup> in a discussion on appendicitis at the Society of Medical Officers of Hospitals at Paris, related a case of uncontrollable vomiting, which he for a long time considered a typical case of nervous dyspepsia. He at last removed the appendix, which was thickened and bound down by adhesions, and the vomiting disappeared at once.

Rendu has seen hysterical symptoms with hiccough disappear immediately after removal of the appendix, showing that they had been reflective in character and dependent upon appendicular colic. R. T. Morris<sup>2</sup> also calls attention to the continuance of dyspeptic phenomena after apparent recovery from an acute attack of appendicitis, and believes them due to the inhibition of the peristalsis of the colon by adhesions of the colon and cæcum, or to fecal concretions causing reflective disturbances. Czerny<sup>3</sup> states that the digestive disturbances and the constipation disappear after the operation, and that considerable increase in weight takes place, particularly when no adhesions are present. I have noticed this in many cases. He also calls attention to a mutual relation between colitis membranacea and appendicitis, particularly as an etiological factor. Chronic appendicitis leads to fecal impaction and to inflammatory conditions of the cæcum, either mechanically or chemically, and a chronic colitis leads to inflammatory conditions of the appendix, by which

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<sup>1</sup> The Lancet, April 3, 1897.

<sup>2</sup> International Journal of Surgery, April, 1900.

<sup>3</sup> Beiträge zur Klin. Chirurgie, 1898, Band xxi. S. 521.

swelling with stasis occurs. The appendicitis, however, is usually the primary affection.

The question of the percentages of recurrence is of interest. Fitz<sup>1</sup> in two hundred and fifty-seven cases had recurrence twenty-eight times,—*i.e.*, eleven per cent.; Krafft in one hundred and six cases had recurrence twenty-four times,—twenty-two per cent.; Hawkins<sup>2</sup> in two hundred and fifty cases had recurrence fifty-nine times,—twenty-three and six-tenths per cent. Of my one hundred and eighty-five cases one hundred and one had had previous attacks,—*i.e.*, fifty-four per cent,—and of these one hundred and one cases twenty-six had had one previous attack, seventeen had had two attacks, twenty-two had had three, and thirty-six had had many.

Another question of interest is the time when the second attack occurred. Albert Wood,<sup>3</sup> in order to determine the probable risk to life insurance companies from this class of patients, examined three hundred and twenty-six cases. Of these two hundred and ten cases had had a second attack before six months, sixty cases had second attack between six months and one year, fourteen cases had second attack between one year and eighteen months, fifteen cases had second attack between eighteen months and two years, eleven cases had second attack between two and three years, three cases had second attack between three and four years, thirteen cases had second attack after five years.

In other words, sixty-four per cent. of second attacks occurred within half a year, eighty-two and eight-tenths per cent. within one year, eighty-seven and one-tenth per cent. within eighteen months, ninety-one and one-tenth per cent. within two years, ninety-four and four-tenths per cent. within

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<sup>1</sup> Loc. cit.

<sup>2</sup> Loc. cit., p. 112.

<sup>3</sup> Medical Record, August 22, 1895.

three years, ninety-four and nine-tenths per cent. within four years, and ninety-six and five-tenths per cent. within five years. We may, therefore, say that the large majority of second attacks occur before the end of two years, and that after that time recurrence will occur in only about nine per cent.

The typhoid and tubercular lesions in the appendix offer nothing to distinguish them pathologically from similar lesions in other parts of the bowels. The frequency with which we meet them has already been mentioned under the etiology. Actinomycosis has been observed in too few cases to be of any great importance; it seems, however, to have produced abscesses in the ileocæcal region, which had some of the symptoms of an appendicitis, particularly a large iliac or retrocæcal abscess.

#### NEW GROWTHS OF APPENDIX.

Primary growths are practically unknown. In an examination of fifteen thousand four hundred and eighty-seven neoplasms from different London hospitals, Mr. Williams could find no mention of any neoplasm involving the appendix primarily.<sup>1</sup> Glacerbrook,<sup>2</sup> however, mentions a case of endothelial sarcoma limited to the appendix; Morris<sup>3</sup> mentions another. The infiltration in relapsing appendicitis may be so hard as to simulate a neoplasm in the right iliac region. Gerster mentions such a case. I have seen and operated on a similar one. Kelly's<sup>4</sup> statistics from the German Hospital in Philadelphia, comprising thirteen hundred and ninety-one cases of carcinoma of the intestine, tend to prove that primary growths of the appendix are the

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<sup>1</sup> Kelynack, loc. cit., p. 139.      <sup>2</sup> Virginia Medical Monthly, 1895.

<sup>3</sup> Lectures on Appendicitis, 1895.

<sup>4</sup> Journal of the American Medical Association, April 7 and 28, 1900.

exception. The rectum was the seat of the new growth in nine hundred and eighty-eight cases, the large intestines in two hundred and fifty-one, the cæcum and the appendix in seventy-nine, the ileum in thirty-two, the jejunum in seventeen, and the duodenum in twenty-four. Kelly could find but five cases in this series in which the carcinoma was clearly limited to the appendix. Of seven hundred and six appendices removed by Deaver, Kelly found three instances of carcinoma and one of endothelioma. He also reports two cases of fibromyoma of the appendix, one in a patient also suffering from fibromyoma of the uterus. In all the cases the clinical manifestations were those of appendicitis, for the relief of which the operation was undertaken.

### SYMPTOMATOLOGY.

We meet frequently more or less strongly marked prodromata. These consist of slight gastro-intestinal symptoms, eructations, light diarrhoea, succeeded by constipation and sudden light colicky pains, particularly around the navel. We find these symptoms still more frequently in patients who already have had one or more acute attacks. An acute attack may, nevertheless, occur without prodromata, in formerly healthy individuals, and commences then, as a rule, with severe pain in the abdomen. This is often considered simply an attack of colic and treated with physic, with the result that the symptoms quickly grow worse on account of the irritation from the increased peristaltic motions. Vomiting occurs a few times, the patient complains of more or less fever, and the pains soon become fixed in the right ileocæcal region, with considerable tenderness to palpation. An indistinct, deep-seated hardness is often felt after twenty-four hours. This may end the attack and all the symptoms may gradually disappear. This is the clinical picture of a com-



mon mild attack of catarrhal appendicitis with adhesive peritonitis.

In other cases the symptoms are more severe. The fever is higher, continuous, often remittent, with evening exacerbations, but the pulse does not go much above 100. The pain is more severe; the right leg is occasionally flexed; rigidity of the muscles in the right ileocaecal region occurs, followed by a swelling, becoming more and more distinct as days pass by. The whole course of the disease is more acute and the patient seriously ill. This picture represents the formation of a perityphlitic abscess. In the most severe cases the pain is intense, rigidity of the abdominal muscles on both sides occurs, the abdomen becomes tympanitic, vomiting returns and often becomes continuous. The vomit is at first greenish, later fecal. The temperature often falls below normal, while, on the other hand, it may be unusually high: the pulse increases in frequency, respiration becomes costal, and the patient dies in a few days from diffuse peritonitis.

Just as there is in the pathology a perfect gradation from the simple catarrhal through the ulcerative to the infectious appendicitis, so is there a perfect gradation clinically from the simple catarrhal appendicitis through a perityphlitic abscess to diffuse peritonitis. "Up to a certain point there is no feature in the symptoms which may enable us to distinguish between a suppurative and a non-suppurative case, and the physical signs in the abdomen are the same. Whether the onset is sudden and severe or gradual and mild, no man can foretell in the first twenty-four hours whether resolution or suppuration, local or diffuse, will be the outcome."<sup>1</sup> "The attack should be closely studied in the course of twenty-four hours, and a careful estimate of

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<sup>1</sup> Hawkins, *loc. cit.*, p. 85.

the probable behavior of the case should, if possible, be made. In the mildest cases the symptoms will be diminishing or at a stand-still; the more marked will be a little worse; in others it is evident that perforation has already occurred. Of a number of cases, all beginning in a somewhat similar manner and all treated conservatively, at the end of a week some will have died of diffuse peritonitis, some will be on the road to recovery, and others again will be waiting for the surgeon to open the abscess, running the risk from hour to hour of serious accidents."<sup>1</sup>

The cardinal symptoms in all forms are pain, tenderness to pressure, rigidity of abdominal muscles, vomiting, fever, and more or less severe symptoms of peritonitis.

#### PAIN.

The pain is by no means limited to the ileocæcal region. It is often referred first to the umbilical region or to the epigastrium or hypogastrium. The umbilical pain seems to be dependent upon direct irritation of the appendix. Fowler<sup>2</sup> saw the same pain produced around the umbilicus by compressing the appendix with Dupuytren's enterotome in a case of artificial anus. Bacon, of New Haven, had a patient complain of severe umbilical pain as he under local anæsthesia compressed the appendix with an artery-forceps in order to amputate it. I have often noticed similar severe umbilical pains produced by the first change of dressing after laparotomy for appendicitis, where drainage has been necessary. The patients complain when the gauze tampon, which is strongly adherent to the stump, is removed. The pain never reaches its greatest intensity suddenly, as in a perforating ulcer of the stomach, but increases gradually during several

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<sup>1</sup> McBurney in *Annals of Surgery*, April, 1891, p. 229.

<sup>2</sup> *Annals of Surgery*, February, 1894, p. 148.

hours.<sup>1</sup> Sharp and intermittent, the pain suggests, and is probably caused by, the passage of gas and fæces by the inflamed area about the ileocæcal valve; dull and continuous, it indicates the presence of a localized peritonitis.<sup>2</sup> Fitz<sup>3</sup> found the pain in forty-eight per cent. of two hundred and thirteen cases in the right iliac region, in thirty-six per cent. over the whole abdomen, in five per cent. in the hypogastrium, in four per cent. in the umbilical region, in two per cent. in the epigastrium, and in one per cent. relatively in the stomach, the hepatic region, or the left iliac fossa. In many instances pain is referred to the right testicle, which is sometimes found retracted.<sup>4</sup> Dieulafoy<sup>5</sup> has noted testicular pain and cremasteric retraction in attacks of appendicitis. On operation, the appendix was found adherent to the iliopsoas muscle, in the neighborhood of the genitocrural nerve; as a branch of this nerve is sent to the cremaster and testicle, the retraction and testicular pain are explained.

The sudden pain is presumably due, not to the actual beginning of the disease, but to the perforation of the appendix, and the more severe the pain the more probable is perforation. Fitz in sixty-one cases found perforation on the first day in forty-one cases,—*i.e.*, sixty-seven per cent.; on the second day in five cases,—*i.e.*, eight per cent.; on the third day in twelve cases,—*i.e.*, twenty per cent.; on the fourth day in two cases,—*i.e.*, three per cent.; and on the fifth day in one case,—*i.e.*, two per cent. Sudden severe pain occurred in eighty-four per cent., in a few cases follow-

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<sup>1</sup> Dieulafoy, Bulletin de l'Académie de Médecine, February 28, 1899.

<sup>2</sup> Richardson, American Journal of the Medical Sciences, December, 1899.

<sup>3</sup> American Journal of the Medical Sciences, October, 1886.

<sup>4</sup> Kelynack, loc. cit., p. 144.

<sup>5</sup> Journal de Médecine et de Chirurgie, 1898, p. 644.

ing diarrhœa, but in most cases in apparently healthy individuals.

The pain in adhesive peritonitis may be dull and aching, either slight or so very severe that the patient may be bathed in perspiration and grow faint.<sup>1</sup>

#### TENDERNESS TO PRESSURE.

This is quite different from the acute pain, which, as we have seen, indicates perforation, and is accompanied by high fever, vomiting, and at the end of twenty-four hours with beginning meteorism and symptoms of severe illness. The tenderness to pressure is a sign of value in early forms and in the chronic forms.

McBurney<sup>2</sup> has pointed out that the most severe tenderness to pressure is found in the middle of the line from the anterior superior iliac spine to the umbilicus. This point (the so-called McBurney's point) corresponds approximately to the insertion of the appendix into the cæcum. Deep pressure with one finger at this point will, therefore, usually be painful. The symptom is, nevertheless, not constant. It may be absent if the appendix is totally gangrenous or in the case of a long appendix extending down into the pelvis and inflamed at the tip while the inner part near the cæcum is healthy. In such a case the most severe pains will be elicited by rectal or vaginal examination. McBurney<sup>3</sup> states that no other acute disease presents this symptom, and that it may clearly be made out from the first hour of the disease up to the end of several days. I have always found it present during the first few days, but other American surgeons do not give it so much importance. Hawkins<sup>4</sup> found

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<sup>1</sup> Hawkins, loc. cit., p. 77.

<sup>2</sup> New York Medical Journal, December 21, 1889, p. 678.

<sup>3</sup> Annals of Surgery, April, 1891, p. 236.

<sup>4</sup> Loc. cit., p. 79.

it present in all cases of adhesive peritonitis from appendicitis, but it was not marked in cases of general peritonitis and may be found in some other abdominal conditions, such as pelvic peritonitis in females. Dieulafoy<sup>1</sup> mentions hyperæsthesia as a peculiar symptom not described by any other author. By tickling the skin over the appendicular region we may provoke a hyperæsthesia more pronounced than elsewhere,—a hyperæsthesia which shows itself by reflex movements, sometimes painful and extending over a part of the abdominal wall.

#### VOMITING.

Vomiting and nausea occur coincident with or shortly after the pain, and are proportionate to the extent of the peritoneum involved; nevertheless, they may be violent and continuous in a local adhesive form and trifling in a general peritonitis.<sup>2</sup> In the milder forms the vomiting generally ceases after the stomach is emptied, but returns later if perforation occurs with development of diffuse peritonitis. It is then first of the usual greenish color, but, as intestinal paresis develops with increasing meteorism, it becomes feculent and continuous. Easy and constant regurgitation is far more serious than occasional violent retching; dark-colored vomiting more serious than biliary.<sup>3</sup> The well-known peritoneal thirst forces the patient to drink continuously, although the fluid is vomited up as quickly as swallowed.

#### CONSTIPATION.

Constipation may precede or accompany the attack, unless a purgative has been used. Occasionally we see more or less diarrhœa through the whole course. Hawkins<sup>4</sup> found this in six out of one hundred and ninety cases. A persistent con-

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<sup>1</sup> Loc. cit.

<sup>2</sup> Hawkins, loc. cit., p. 77.

<sup>3</sup> Richardson, loc. cit.

<sup>4</sup> Loc. cit., p. 78.

stipation in the beginning points towards a serious attack and is often the precursor of a regular ileus. Constipation depends upon paralysis of the affected part of the bowel. If this is limited, and the tumor small, borborygmus may occasionally be seen above, particularly during resolution. Lennander<sup>1</sup> points out that ileus may occur without diffuse peritonitis and depend upon a simple local adhesive form, which produces mechanical obstruction by adhesions or kinking or organized exudations forming a band. I have met two such cases.

#### RIGIDITY.

Rigidity of the abdominal muscles—both the rectus and the oblique muscles—is a symptom which we always meet when the inflammation has approached the anterior abdominal wall and the parietal peritoneum becomes involved by adhesions to the bowels, the omentum, and the mesenterium. The muscles act as sentinels, so to speak, and may be felt as hard as a board. Rigidity with distinctly localized pain in the right lower quadrant strongly suggests appendicitis; with fever, it almost proves it; with tumor, it fully establishes the diagnosis.<sup>2</sup> Rigidity may, however, be absent in very early cases or in cases in which the position of the appendix is behind the cæcum or down in the pelvis. Tenderness is, however, present. The rigidity is present on the right side alone as long as the peritonitis is localized, but occurs on both sides as soon as the peritonitis becomes universal by the perforation of a gangrenous appendicitis or of a local abscess. This is, therefore, an ominous symptom.

#### TUMOR.

Muscular rigidity may continue as long as acute symptoms are present, but it generally lasts only a few days, and a

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<sup>1</sup> Loc. cit., p. 24.

<sup>2</sup> Richardson, loc. cit.



tumor or a resistant mass may usually then be felt, fairly hard and well defined upward and inward, with the long axis above and parallel with the outer part of Poupart's ligament, but otherwise variable in size and shape. Hawkins<sup>1</sup> thinks that it depends upon congestion, œdema, and swelling of the wall of the cæcum and of the ileum in the iliac region, the interstices between the coils containing coagulated fibrinous exudation and producing fixation of the cæcum and adjacent coils. Hawkins considers this fixation the principal cause of the hardness, although the thickened omentum may play a *rôle* too. I consider it improbable that fecal accumulations in the cæcum have anything to do with the hardness, as in one hundred and fifty-eight laparotomies I found the cæcum empty in every case.

Sahli<sup>2</sup> does not believe that the tumor ever depends upon fecal accumulations or upon serofibrinous exudations. In many cases, he believes, it is formed by the increasing amount of pus; in others, particularly where the disease disappears spontaneously, without perforation of an abscess, it depends upon thickening and infiltration of the wall of the cæcum and the appendix, and of the visceral and parietal layer of the peritoneum; in some cases, upon infiltration of the fascia transversa and the abdominal muscles; and, lastly, upon the thickened omentum. Roux<sup>3</sup> mentions such a case of thickening of the fascia and omentum. The primary cause of the tumor, Sahli believes, is the enlargement of the inflammatory focus in the appendix,—*i.e.*, the empyema. Pus is always present in every kind of tumor. Sahli explains the spontaneous recovery of so many cases, although pus is

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<sup>1</sup> Loc. cit., p. 87.

<sup>2</sup> Ueber die Pathologie und Therapie der Typhlitiden, Verhandlungen des 13 Congresses für Innere Medicine in München, 1895, S. 204.

<sup>3</sup> Loc. cit.

present in them all, in the following way: in the lighter forms, only small amounts of pus will be found; it may become reabsorbed, or it may probably in numerous cases perforate into the cæcum, through the natural but narrowed opening, and not through the wall.

Fitz<sup>1</sup> rarely saw the tumor before the third day, but thinks that it is sure to form if the patient lives long enough. The swelling may be found primarily in the retrocæcal tissue in cases in which the appendix is retrocæcal. Kelynack<sup>2</sup> and Talamon<sup>3</sup> are more or less sceptical in regard to the appearance of a tumor until later in the disease, and believe that the muscular rigidity will prevent all deep exploration. It depends, however, upon how the exploration is carried out. If done gently and with the whole hand, we may explore quite well without producing increased rigidity or severe pain. The rigidity disappears, besides, under anæsthesia, and a resistance or tumor will then, according to my experience, always be found as early as the second day, save in cases in which the appendix extends far down into the pelvis or is retrocæcal, or in cases of primary diffuse peritonitis, in which nature makes no attempt towards limiting the inflammation by exudations and adhesions. Tumor, however, is a better guide to treatment than any other sign, but the same significance should not be given to its absence.<sup>4</sup>

In endeavoring to discover swelling and tenderness a rectal or vaginal examination should never be omitted, since it is by no means rare to find that the inflammation is located in, or has extended into, the pelvis.<sup>5</sup> In the same way may be noted absence of local swelling in gangrenous appendicitis

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<sup>1</sup> Loc. cit., p. 342.

<sup>2</sup> Loc. cit., p. 145.

<sup>3</sup> Loc. cit., p. 89.

<sup>4</sup> Richardson, loc. cit.

<sup>5</sup> Van Hook, Journal of the American Medical Association, February 20, 1897.

and in perforative appendicitis with diffuse peritonitis. In the latter case, however, we find a widely diffused tenderness.

#### TYMPANITES.

Tympanites may in the beginning be partial, limited to the immediate surroundings of the cæcum, where it may produce a local protrusion resembling an abscess. The tympanites increases quickly in the diffuse peritonitis, with rigid and hard walls and complete paralysis of the intestinal canal. Distention may, however, occur without diffuse peritonitis being present, from adhesive bands or from obstinate constipation, often during opium treatment. Richardson<sup>1</sup> distinguishes between the two conditions with the stethoscope, nothing being heard if diffuse peritonitis is present, while the peristaltic action produces gurgling sounds if the distention is due to accumulation of gas without peritonitis.

#### PERCUSSION.

By gentle percussion a certain amount of dulness may often be detected, unless the swelling is very deep-seated. The dulness increases usually as the abscess grows larger and becomes more superficial, pressing the bowels away from the anterior abdominal wall. It may be tympanitic when the infiltration is covered with distended bowels, or the abscess contains air. I do not, however, consider percussion of any particular value in the early forms, which, in our days, usually will be treated by early operation.

#### TEMPERATURE, PULSE, ETC.

The higher we find the temperature and pulse in the beginning the more serious will the attack be, as a rule, and the more probable the formation of an abscess or gangrene with

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<sup>1</sup> Loc. cit.

perforation. Perforation may, however, also occur with slow pulse and low temperature. We often see after perforation that the temperature falls or even becomes subnormal, while the pulse becomes quick and small. The initial temperature ranges from 102° to 104°, but it may reach 105° F. In a general way low temperature indicates the presence of the colon bacillus, high, that of the streptococcus.<sup>1</sup> In the milder forms there is a steady fall of the temperature after the first day or two, while in cases in which suppuration occurs there is continuous fever from the first day of illness till the abscess is opened.<sup>2</sup> Occasionally we see a sudden cessation of the fever. Hawkins considers it probable that it coincides with the discharge of an abscess into the bowel. In cases of gangrene and diffuse peritonitis the temperature frequently is low for two or three days before death; it may, however, rise to 104° or 106° F.

The pulse is proportionate to the temperature in the adhesive and suppurative cases, but has no relation whatever to the temperature in cases of perforation with diffuse peritonitis. I consider the pulse of far more importance than the temperature. A pulse considerably quicker than the temperature would lead us to expect (for instance, pulse 130, temperature 100° F.) shows, in my experience, that perforation has occurred and that diffuse septic peritonitis is present. A high pulse-rate is, therefore, one of the most important symptoms, and has a distinct bearing on the question of operation. Willy Meyer<sup>3</sup> says pointedly, and I perfectly agree with him, that if the pulse, with all symptoms well developed, has a tendency to go above 116 or 118, still more if it goes up to 120 or higher, and stays there, we should operate at once. If this happens with low temperature, opera-

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<sup>1</sup> Richardson, loc. cit.

<sup>2</sup> Hawkins, loc. cit., p. 87.

<sup>3</sup> Medical Record, February 29, 1896.

tion is still more urgent. Other surgeons also emphasize the importance of the pulse. Most alarming forms of appendicitis may, however, exist without sensible deterioration of the pulse. This happens particularly in cases of total gangrene of the appendix, and is probably due to thrombi both in the veins and lymphatics, so that the toxins are not absorbed.

A chill shows that suppuration has occurred and that absorption of its products has commenced. It may, however, be absent even in cases with large abscesses.

**Costal respiration**, particularly in males, is an important symptom of diffuse peritonitis, but may occur in a moderate degree in gangrenous forms without perforation. I also consider this an absolute indication for immediate operation. The greater the meteorism, the more perfect the costal respiration.

The tongue is more or less furred in the milder forms, dry and fissured in diffuse peritonitis.

**Irritable Bladder.**—This symptom is found only in cases of long inflamed appendices extending downward into the pelvis and depends probably on a pericystitis. Hawkins<sup>1</sup> found it present in five of one hundred and ten cases. According to Duret,<sup>2</sup> it is found in from twenty to thirty per cent. of all cases, and does not depend upon reflex irritation. He mentions three classes of symptoms which may occur: (1) Prolonged retention, dysuria, pyuria, and even pyelonephritis. There is, however, no communication between the appendix and the cavity of the bladder; simply a pericystitis with secondary infection of the wall. (2) A peri-appendicular abscess may perforate into the bladder and form pyo-stercoro-vesical or pyo-stercoro-intestino-vesical fistulas, and the urine contain foreign material. I have seen a case which could not be explained in any other way. It

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<sup>1</sup> Loc. cit., p. 78.

<sup>2</sup> Le Progrès Médicale, November 11, 1899.

was that of a man sixty years of age, who suddenly developed anuria, while at the same time the urine was voided by the rectum. No fistula could be discovered in the rectum, but colored fluid injected into the bladder was voided by the rectum in the course of half an hour, showing that there was a communication with the intestines higher up. The patient recovered by external urethrotomy and draining of the bladder for four weeks. The bladder contained fecal material. (3) Irritable bladder may be due to perivesical concretions, either stercoral or stercoro-urinary or simple urinary.

Reymond has called attention to the possibility of the formation of intravesical concretions as the result of an infection alone, probably like the formation of a gall-stone around a nucleus of colon bacilli.

**Contraction of the Ilio-Psoas Muscle.**—This contraction is stated by different authors to be quite a constant symptom. I have, however, never seen it, and I consider it an exception. The ilio-psoas muscle is well protected by the strong iliac fascia, and I believe it is exceptional to find a retroperitoneal abscess perforate this fascia and attack the muscle itself.

### LEUCOCYTOSIS.

Leucocytosis, according to Cabot's<sup>1</sup> definition, is the presence in the blood of an increased number of white cells of the same varieties morphologically as those in normal blood, a plurality in the inflammatory form—and generally an overwhelming plurality—being polynuclear. It is found particularly where pus is present. Richardson considers it an invariable symptom in perforative appendicitis. I believe it is always present where we find pus, and I have demonstrated

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<sup>1</sup> Sprague, Diagnostic Value of Blood Examinations, Medical Record, September 26, 1896.



it in very early cases before other distinct symptoms of sup-puration were present. In doubtful cases of appendicitis its presence will be of diagnostic value. There is no leucocytosis in typhoid fever. In a recent case at the Sisters' Hospital the presence of leucocytosis in a supposed case of typhoid fever led to the discovery and early operative treatment of a subphrenic abscess.

From one hundred cases of appendicitis in the Massachusetts General Hospital, Dr. R. B. Greenough<sup>1</sup> has drawn the following conclusions in regard to the relation of leucocytosis to appendicitis: (1) Leucocytosis may be considered a fairly constant symptom of appendicitis. (2) The presence or absence of leucocytosis, or the degree of leucocytosis, without other data, is not sufficient to determine the local condition of the appendix and its surroundings. (3) In a series of cases the degree of leucocytosis corresponds roughly with the degree of temperature, but in individual cases great variations are found. (4) The degree of leucocytosis, when considered in connection with the duration of the attack, is of considerable assistance in the diagnosis of the local condition. (5) A high leucocytosis (above 20,000) on the first or second day of disease suggests general peritonitis. (6) A low blood-count (below 10,000) after the first week, if accompanied by severe symptoms, indicates general peritonitis, and is of grave prognostic significance; but, if accompanied by mild symptoms, denotes a mild catarrhal process or a walled-off abscess which has become subacute in character. (7) A high leucocytosis (above 20,000) after the first week or ten days may be taken to indicate a local abscess.

#### URINE.

The urine is usually high-colored, containing in the septic cases some albumin. It is diminished in quantity according

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<sup>1</sup> Richardson, American Journal of Medical Sciences, February, 1899.

to the fall of the arterial tension; it may cease completely; occasionally it contains indican. Purdy<sup>1</sup> believes that the appearance of large quantities of this substance indicates that abundant albuminous putrefaction is progressing in some part of the system. In obstructive diseases of the small intestines, he says, its excretion is enormously increased.

#### DILATATION OF THE VEINS.

This symptom is frequently seen in the right iliac region, and simply indicates great tension in the deeper layers. It is proportionate to the size and extension of a localized infiltration and abscess.

#### GENERAL SYMPTOMS.

These depend upon the extent and severity of the peritonitis. There is great restlessness; the voice is feeble; the facial expression is anxious, with deep-set eyes and sharp features,—*facies Hippocratica sive abdominalis*; the increasing meteorism, with short, thoracic respiration, the small, quick and feeble pulse, the persistent vomiting, and the profuse, clammy perspiration are all symptoms of general peritonitis. The extremities become cool on account of interference with respiration and circulation, the secretion of urine ceases, and death ensues at last as the result of oedema of the lungs. The pains cease towards the last; the patients are in a condition of euthanasia and, as a rule, conscious almost to the end. The positive symptoms—the pain, vomiting, and fever—may, however, abate and disappear and the patient feel much relieved, although there may be no real improvement. Dieulafoy<sup>2</sup> calls this “a treacherous lull of

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<sup>1</sup> Practical Ureanalysis and Urinary Diagnosis, Philadelphia, 1895, p. 44.

<sup>2</sup> Le Progrès Médical, February 11, 1899.

appendicitis" which may exist when there is gangrene, peritoneal septicæmia, or diffuse peritonitis present. It is brought about by the use of morphine and ice-bags. The abdomen, however, remains somewhat tympanitic, rigidity does not entirely disappear. The pulse is more or less rapid, and albuminuria and icterus are by no means unusual. In such cases operation is often delayed till fatal diffuse peritonitis takes place. In a paper based upon sixty-four cases seen during the last three years, Dieulafoy<sup>1</sup> mentions as a special form appendicitis larvata, in which pain, rigidity, and cutaneous hyperæsthesia may be present, but are disguised by other symptoms. Bilious vomitings form the predominant symptoms and feign a common indigestion, while they in reality prove appendicular infection. Sometimes an appendicitis larvata is disguised by a profuse diarrhœa, by the aid of which the intestines try to get rid of the enemy. One must be on his guard in order not to confound it with an enteritis or enterocolitis. Treves<sup>2</sup> states that in the masked cases, which, fortunately, are uncommon, practically all the ordinary symptoms of perityphilitis may be absent.

#### CHRONIC RECURRING APPENDICITIS.

This form is characterized by the occurrence of distinct attacks separated by well-defined intervals. The attack itself is in no way different from that of any other form, and may lead, although not frequently, to perforation with local or diffuse peritonitis. The symptoms depend, therefore, upon the severity of the attack. During the interval the patient complains of more or less light, gastro-intestinal disturbance, accompanied by mild, often lancinating pains, or an indescribable feeling of heaviness and tenderness in the ileocæcal

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<sup>1</sup> Bulletin de l'Académie de Médecine, February 28, 1899.

<sup>2</sup> Clifford Allbutt's System of Medicine, vol. iii., 1897.

region, which continually calls the patient's attention to this region, particularly when he stands erect. One or more attacks have, as a rule, preceded these symptoms. In the majority of these cases we will by Edebohls's method (which will be described later) be able to feel a hard, indurated, tender, and more or less adherent appendix. Some authors describe also as a distinct variety *relapsing appendicitis*, in which perfect recovery takes place before a new attack occurs. I consider this form doubtful, and believe, upon the whole, that it does not exist.

Fowler<sup>1</sup> mentions as special forms *subacute*, *chronic*, *recurring*, and *relapsing* appendicitis. I see no reason for making these subdivisions. If perfect recovery fails to take place,—and I believe that it happens only in the mildest cases, which cannot be diagnosed clinically, or after perforation with formation of a local abscess and destruction of the appendix, or lastly, in total obliteration of the appendix,—pathological changes will occur in the appendix, which will lead to relapses sooner or later. These pathological changes are all chronic in their nature, and consist in thickening of the mucous membrane, with formation of strictures, dilatations, adhesions, and bends, all favoring the development of coprolites and the growth of microbes, and, in that way, recurrence of the attack. They are all included under the name *chronic recurring appendicitis*.

### COMPLICATIONS AND SEQUELS.

Various complications may be met with during the course of appendicitis.

Peritonitis, unless we consider it merely a symptom, is necessarily the most frequent and, on account of the great mortality, the most important.

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<sup>1</sup> Annals of Surgery, January, 1894, p. 36.

**Intestinal obstruction** is a very important, although not very frequent, complication. It may be due to adhesions and agglutinations of the coils or to the formation of adhesive bands. Mild forms are not uncommon in the adhesive variety, on account of paresis of the affected neighboring part of the intestines. They are accompanied by borborygmus. The severe forms happen more frequently in cases of local abscess. In ten fatal cases of perityphlitic abscess Hawkins<sup>1</sup> found that intestinal obstruction was the cause of death in four. I have seen three such cases, in connection with perityphlitic abscesses. In one case, whose history I do not possess, the patient had been sick six weeks with appendicitis. During the last two weeks he had all the symptoms of intestinal obstruction, with incessant fecal vomiting. At the consultation I found an enormous intraperitoneal abscess, containing several quarts of pus and occupying almost the whole right side of the abdomen. It contained fecal concretions. The operation did not relieve the obstruction and the patient died five days later. No further operation and no post-mortem were allowed. It may also result from diffuse peritonitis, on account of the adhesions. The prognosis is better in these cases, as the obstruction rarely is absolute, and as the adhesions gradually become absorbed again.

**Pylephlebitis and Hepatic Abscess, etc.**—The hepatic abscess depends upon the extension of a septic thrombosis, starting in the veins of the mesentery or the omentum, through the portal vein into the liver; or it may be the result of a septic embolus, in which case we may find a single liver abscess. The pylephlebitis is, however, the primary lesion. Hawkins<sup>2</sup> had one case of hepatic abscess in thirty-eight cases; Fitz,<sup>3</sup> eleven in two hundred and fifty-seven cases. I<sup>4</sup> have seen this complication twice in one hundred and

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<sup>1</sup> Loc. cit., p. 94.

<sup>2</sup> Loc. cit., p. 97.

<sup>3</sup> Loc. cit.

<sup>4</sup> International Journal of Surgery, April, 1896.

eighty-five cases. In some cases infection passes beyond the liver and becomes systemic with abscesses in the brain, lung, etc. Bryant<sup>1</sup> mentions a case in which there was found an abscess of the liver and another between the diaphragm and the liver, which had extended to the pericardium and produced suppurative pericarditis.

Pylephlebitis is absolutely fatal. A simple hepatic abscess from embolus may recover by operation. The symptoms of pylethrombosis depend principally upon the occlusion of the portal vein, and consist in rapidly occurring ascites, swelling of the spleen, watery diarrhœa mixed with blood, and dilatation of subcutaneous veins,—*i.e.*, caput Medusæ. The symptoms of pylephlebitis depend less upon occlusion of the portal system than upon septic and thrombo-pyæmic processes. Dieulafoy<sup>2</sup> proposes the name appendicular liver for this hepatic affection frequently dependent upon appendicitis, even when it apparently is benign. It leads to the quick formation of multiple abscesses which change the liver into a kind of purulent sponge and is always fatal. It occasionally commences when the patient is apparently convalescent, and is ushered in by violent fever, pain, and rapid enlargement of the liver. Icterus is always present, vomiting and diarrhœa frequently. Dieulafoy<sup>3</sup> also mentions that icterus may occur in another way, by the absorption of toxins and probably by their deleterious influence upon the blood. He has had three clinical cases of this toxic icterus, which he considers different from the severe and fatal infectious icterus caused by pylephlebitis. The toxic form is generally slight, shows itself by moderate icterus and albuminuria, and dis-

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<sup>1</sup> Harveian Lectures, British Medical Journal, December 20, 1884, p. 1228.

<sup>2</sup> Journal de Médecine et de Chirurgie, 1898, p. 922.

<sup>3</sup> Deutsche Medicinische Wochenschrift, Vereinsbeilage vi., January 5, 1899.



appears quickly after operation. I have seen four such cases among my one hundred and eighty-five cases, and they all recovered promptly. I look upon the icterus more as a coincidence, dependent upon duodenal catarrh and slight obstruction of the gall-ducts. "All the evidence tends to indicate that there is no such occurrence as hæmatogenic jaundice."<sup>1</sup> We shall probably meet these complications less frequently as early operations are performed.

Instead of pericarditis right-sided *pleurisy* has been observed. It may also complicate diffuse peritonitis. Hawkins<sup>2</sup> mentions several such cases, and calls attention to the bacillus coli, which has been found in lung complications after intestinal diseases. Bryant<sup>3</sup> mentions an abscess perforating the diaphragm and followed by pneumonia and another followed by double pleurisy.

**Phlebitis and thrombosis** of the iliac vein, succeeded by œdema of the right leg, may occasionally be found. Hawkins<sup>4</sup> thinks that it probably depends upon contraction of inflamed retroperitoneal tissue around the iliac vein. I believe that it depends more upon great prostration and weak circulation, as I in one case found thrombosis of the left femoral vein. That such a thrombosis may produce emboli in the lung is evident; I have myself met with such a case.

**Fatal hemorrhage** has occasionally occurred from ulceration of the walls of the vessels. Bryant<sup>5</sup> mentions one case from ulceration of the deep circumflex artery, Fowler<sup>6</sup> another from ulceration of the iliac vein. I have had a fatal

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<sup>1</sup> H. J. Waring, Diseases of the Liver, etc., London, 1897, p. 35.

<sup>2</sup> Loc. cit., p. 111.

<sup>3</sup> British Medical Journal, December 20, 1884, p. 1128.

<sup>4</sup> Loc. cit., p. 100.

<sup>5</sup> British Medical Journal, December 13, 1884, p. 1183.

<sup>6</sup> Annals of Surgery, January, 1894, p. 41.

result from hemorrhage of a large mesenteric vein eight days after the operation of a totally gangrenous appendicitis.

**Parotitis.**—Stephen Paget<sup>1</sup> has collected one hundred and one cases of inflammation of the parotid following injury and disease of the abdominal wall and pelvis, fifty of which were due to injury and disease of the generative organs, eighteen to injury and disease of the alimentary canal, and twenty-three to injury and disease of the abdominal wall, peritoneum, and pelvic cellular tissue; in five cases it followed perityphlitis. Floystrup<sup>2</sup> saw three cases in one hundred and fifty-six cases of perityphlitis at the Commune Hospitalet in Copenhagen. This form of parotitis is not, as a rule, accompanied by signs of septicæmia or pyæmia. Septic symptoms were present in only fifteen of Paget's one hundred and one cases, and secondary abscesses in the lung and kidney were found in only seven. In no case were joint affections present. The affection has no fixed period of incubation and runs no regular course. There are generally no rigors nor is there any great rise of temperature. It may subside, start up and subside again, and the danger lies not in the parotitis, but in the primary lesion.

**Fæcal fistula** is seen less often in our days, on account of early operation. Formerly, when a perityphlitic abscess was left to itself, it discharged in favorable cases into the cæcum, ileum, bladder, rectum, or vagina, or outward through the abdominal wall. Bull<sup>3</sup> saw in forty-seven such cases perforation occur externally through the abdominal wall twenty-eight times, into the cæcum fifteen times, into the rectum twice, and into the bladder twice. Paulier<sup>4</sup> gives the pro-

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<sup>1</sup> Parotitis after Injury and Disease of the Abdomen and Pelvis, *British Medical Journal*, March 19, 1887, p. 614.

<sup>2</sup> Perityphlitis og. dens Behandling, Kjöbenhavn, 1888, p. 32.

<sup>3</sup> Quoted by Kelynack, *loc. cit.*, p. 133.

<sup>4</sup> *Ibid.*

portion of external fistulæ as much less : among forty-six cases only four opened externally while fifteen opened into the cæcum. In our days fistulæ happen occasionally after operation, from the ligature cutting through the appendix or when applied around gangrenous appendices. Dawbarn's method of treating the stump by invagination prevents absolutely such an eventuality, but it cannot be used when the appendix is gangrenous up to the insertion. In such cases part of the cæcum may also become gangrenous, and in spite of infolding of the gangrenous part, be followed by fecal fistulæ. I have seen three such cases. The fistulæ, however, healed spontaneously in a few weeks. The gangrene may, however, extend to the whole cæcum and the patient die from septicæmia or diffuse peritonitis, as happened in one of my cases. External fistulæ may occur not infrequently after operations on local circumscribed abscesses in which the appendix is left behind. These fistulæ also usually heal spontaneously in a few weeks.

**Appendicitis complicating pregnancy** leads to miscarriage and seems to be often fatal. Fowler<sup>1</sup> had four cases in one hundred and forty-three cases of appendicitis, all entering with diffuse peritonitis and all dying. Howard Crutcher<sup>2</sup> reports another fatal case, in which miscarriage occurred in the eighth week of pregnancy. The patient developed apparently septic peritonitis, thought to be due to puerperal sepsis. Eighteen days later a median explorative laparotomy was made and an enormous perityphlitic abscess opened, which depended upon a perforated appendix. I do not see why this complication should be so serious if the diagnosis is made early and operation performed in time.

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<sup>1</sup> *Annals of Surgery*, January, 1894, p. 46.

<sup>2</sup> *Medical Record*, September 26, 1896.

Dieulafoy<sup>1</sup> considers the prognosis more serious when the patient is pregnant, although an operation, if done in time and according to rules, is no more serious than in plain cases of appendicitis. Pregnancy seems, however, to favor an attack of appendicitis, and coprolites are frequently found. R. T. Morris<sup>2</sup> believes that appendicitis frequently occurs during pregnancy because the appendix hangs over the pelvic brim in about thirty-five per cent. of the cases and in this position is liable to become bruised by the enlarging womb, and because in many cases adhesions exist which are likely to be broken up and to excite appendicitis. Abrahams<sup>3</sup> states that of the total number of reported cases of pregnancy complicating appendicitis, eight resulted in recovery and eight in death. In all cases but one there was a history of obstinate constipation. The presence of the enlarged uterus may interfere somewhat with palpation, but local signs can be recognized by careful examinations. In obscure cases anæsthesia should be employed. Operation ought to be performed in cases of old appendicitis lit up during pregnancy, even if mild, especially if the attack occurs early in pregnancy. Tubal pregnancy is of importance as regards differential diagnosis up to four months, when rupture occurs.

Phlegmonous inflammations of the pelvic connective tissue, in the lumbar region, around the kidney, in the anterior abdominal wall, etc., are mentioned as complications by different authors. I do not consider them complications at all. They are simply the normal development of abscesses dependent upon abnormally situated appendices.

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<sup>1</sup> Journal de Médecine et de Chirurgie, 1898, p.922.

<sup>2</sup> Medical Record, December 5, 1896.

<sup>3</sup> Ibid.

## DIAGNOSIS.

Few diseases have a more uniform set of symptoms than appendicitis. The cardinal symptoms—sudden onset with fever, pain in the right ileocæcal fossa, rigidity of the abdominal wall, vomiting and nausea followed by tumor—are as characteristic of appendicitis as the violent chill, the pain in the side, and the rusty expectoration are of pneumonia.<sup>1</sup> Few diseases, however, present so many stages, each characterized by a different set of symptoms, and yet only in degree differing from the preceding and following stages; every one of the cardinal symptoms may be lacking or indicate something else. It is their combination and their appearance in a distinct order that make the diagnosis sure. The pain, for instance, may be lacking in the ileocæcal region, when there is a long appendix, inflamed at the tip, extending down in the pelvis. It may be completely absent in a totally gangrenous appendix, and the patient be resting quietly in bed with normal temperature, pulse, and respiration.<sup>2</sup> “The reason why the appendix is free from tenderness is because it is dead, nerves and all.” The temperature and pulse are normal because toxins are not escaping into the general circulation. The severity of the pain may be of all degrees, from a local tenderness to the most excruciating agony. The tumor may be absent in very acute forms, with rapidly diffuse peritonitis, or in retrocæcal or pelvic positions of the appendix; similar conditions may lack the otherwise constant symptom of rigidity of the abdominal wall. One symptom, however, *tenderness to pressure*, is always present, but even this may be found with other conditions than appendicitis.

Edebohls's method of palpation is an important diagnostic

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<sup>1</sup> Talamon, loc. cit., p. 145.

<sup>2</sup> Morris, Lectures on Appendicitis, New York, 1895, p. 41.

advance.<sup>1</sup> He maintains that a competent gynæcologist is able to palpate a normal tuba, not to mention a pathological and swollen one, and he has shown that in most cases (in not too fleshy individuals) it is just as easy to palpate a normal appendix as a normal tuba, and that palpating a pathological, stiff, and swollen appendix is a very simple thing after some experience. We might theoretically suppose that it would be difficult or impossible to palpate the appendix, on account of its variable position and of its frequent situation behind a cæcum filled with fecal matter. We may in regard to the first point state that the insertion of the appendix is approximately constant at McBurney's point and that only the outer end varies. We may, therefore, feel confident of being able, in the majority of cases, to palpate the inner part of the appendix, and the condition of this part will give us valuable information about the condition of the rest of the appendix. In regard to the second point, Edebohls insists that it is a mistake to believe that the cæcum normally is filled with fæces; on the contrary, it is, according to his investigations, generally empty and collapsed, and the appendix may be palpated through its walls.

The palpation is done as follows. The patient lies on his back, with limbs flexed at the hips. Placing three or four fingers of our right hand flat on the abdomen, we feel for the margin of the right rectus muscle, in the line between the navel and the anterior superior spine of the ilium. The fingers are introduced with a light, steady pressure under the margin of the rectus until we feel distinctly the pulsation of the common iliac artery. The appendix is felt, as a rule, just outside the artery, its insertion about an inch distant, while its tip often crosses the artery. We move the fingers

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<sup>1</sup> Diagnostic Palpation of the Appendix Vermiformis, American Journal of the Medical Sciences, May, 1894.



slowly outward as soon as we feel the pulsation of the artery and note with care the condition of the posterior abdominal wall,—that is, the ileo-psoas muscle covered with the iliac fascia. This is the point of resistance against which we compress the appendix and which makes it possible to palpate it. I have, as a rule, found it advantageous to apply the left hand on the palpating right hand; we are thereby able to press more evenly and steadily. The normal appendix is felt as a thin, flat band which slips away under the fingers and is painless. It feels hard, round, unyielding, and more or less movable and tender under pressure when it is in a condition of chronic inflammation. We may also, as a rule, get a reliable idea about the direction of the appendix, except when it extends downward into the pelvis.

I have in a number of cases made out its position by palpation and verified it during the succeeding operation. The method is of exceeding importance in chronic appendicitis, and an operation is not indicated unless we feel the thickened and swollen appendix. We cannot, of course, use the method in acute forms except just at the commencement; the pain is too severe, and we run the risk of rupturing a gangrenous or pus-filled appendix. The palpation is still easier under narcosis. I have, nevertheless, in several cases, where I was sure of feeling a hard, indurated appendix extending downward, found it in a diametrically opposite direction. What I felt was the flat tendon of the psoas minor muscle, which in a thin subject may feel like a hard, indurated cord.<sup>1</sup> We may, therefore, say that the diagnosis of appendicitis usually is easy by a careful consideration of the different symptoms appearing in a certain order, although a great many different lesions may present one or more of these symptoms, particularly in the early stages of the dis-

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<sup>1</sup> Henle, *Handbuch der Muskellehre des Menschen*, S. 243.

ease. I perfectly agree with Richardson's<sup>1</sup> statement that "a positive diagnosis, in the first twenty-four hours, cannot always be made; the symptoms of a great variety of acute abdominal lesions begin in precisely the same way. Perforation of the stomach, acute cholecystitis, acute pancreatitis, mesenteric thrombosis and embolism, extravasation from the intestines, acute salpingitis, ovarian tumor with twisted pedicle, rupture of abscesses, acute intestinal obstruction, congenital malformations of the intestines, ruptured extra-uterine pregnancy,—in fact, almost all acute abdominal lesions present symptoms that may suggest appendicitis as strongly as anything else; but so do acute intestinal disturbances dependent upon errors in diet, acute gastric and intestinal catarrhs, ptomaine-poisoning, cholera-morbus, or even lead colic."

Another question, however, is whether we can diagnose *the form of the appendicitis* present, particularly whether it will perforate, or has already perforated, or is forming a localized abscess. The importance of these questions cannot be too much emphasized, as they are intimately connected with the prognosis and the treatment. Murphy<sup>2</sup> says (and I believe all surgeons will agree with him) that we can positively determine when appendicitis is present, but that in most cases we cannot say how extensive, how dangerous, and how far-reaching the effect of that appendicitis may be. We have no sign, symptom, or combination of signs and symptoms that indicates with any degree of certainty suppurative peritonitis in the early stages. The diagnosis is easy enough if we wait till the disease has developed and the symptoms of a local abscess or diffuse peritonitis are present, but we have then lost the favorable time for opera-

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<sup>1</sup> American Journal of the Medical Sciences, December, 1899.

<sup>2</sup> Medical News, January, 1895.

tion and will lose a number of our patients who by earlier operation surely would have recovered.

In regard to the question whether an *appendicitis will perforate*, we must fairly acknowledge that we are in many cases unable to forecast the future. Talamon<sup>1</sup> believes that chronic relapsing appendicitis is the only form in which we may feel confident that perforation will not occur, and even then only after the third or fourth attack, the perforation being less and less probable the more frequently the attacks are repeated. I do not, however, believe that this is a correct statement. Of one hundred and fifteen patients of mine who either had perforation with local circumscribed abscess or diffuse peritonitis, or else had total gangrene of the appendix without perforation, sixty-nine gave a history of no previous attacks, while twelve had one attack, ten two attacks, eleven three attacks, and thirteen many attacks. Forty per cent. of my suppurative cases may therefore properly be designated as chronic recurring cases, while twenty per cent. had had three or more attacks. We can scarcely, therefore, agree with Talamon that we are able to foresee from the beginning the course of the disease in the chronic recurring forms.

Hawkins<sup>2</sup> says that "whether the onset is sudden and severe or gradual and mild, no man can foretell in the first twenty-four hours whether resolution or suppuration will be the outcome. Neither the height of the initial fever nor the severity of the pain, vomiting, or general constitutional disturbances can be taken as giving any clue to the subsequent course of the disease."

It is quite another question *whether perforation has already occurred*. Talamon<sup>3</sup> states that by the third or fourth day, in the immense majority of cases, the difficulty of diagnosing

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<sup>1</sup> Loc. cit., p. 170.

<sup>2</sup> Loc. cit., p. 84.

<sup>3</sup> Loc. cit., p. 172.

this hardly exists, as at that time one either observes or does not observe the signs of an acute peritonitis. The point, however, is to diagnose it before acute peritonitis is present, and not to wait for the symptoms of peritonitis. Murphy<sup>1</sup> states that fifty per cent. of the fatal cases die before the sixth day, many on the fourth, and a smaller number on the second, and that the surgeon who waits until the sixth day necessarily will lose fifty per cent. of all the cases that would die without operation.

We do not, however, lack important symptoms of warning during the first two days, even if we cannot in every case be absolutely sure of the condition of the appendix and the probable course of the disease. First of all, I wish to call attention again to the great importance of the pulse-frequency. If this corresponds to the height of the fever we may feel comparatively secure, but if the pulse rises quickly to 110 or 115, or if it goes up to 120 or higher and stays there, perforation is probably present and diffuse peritonitis developing, although perforation may occur with low temperature and slow pulse.

The severity of the pain is also in the majority of cases of diagnostic importance: I believe that severe pain shows that perforation has already occurred. Fitz<sup>2</sup> has particularly called attention to this point. Sudden severe pain occurred in two hundred and sixteen of two hundred and fifty-seven cases,—i.e., eighty-four per cent.,—in a few following diarrhoea, but in most instances occurring in apparently healthy individuals. He considers the sudden pain presumably due not to the actual beginning of the disease, but to separation of fresh adhesions and often, perhaps usually, to perforation of the inflamed appendix. In sixty-one cases this occurred

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<sup>1</sup> Medical News, January 5, 1895.

<sup>2</sup> American Journal of the Medical Sciences, October, 1886.

on the first day in forty-one cases, or sixty-seven per cent. ; on the second day in five cases, or eight per cent. ; on the third day in twelve cases, or nineteen per cent. ; on the fourth day in two cases, or three per cent. ; on the fifth day in one case, or two per cent. Shradý,<sup>1</sup> too, is of the same opinion, and states that the sudden occurrence of intense localized pain usually indicates a dangerous change, either perforation or the tearing of adhesions and rupture of an abscess, and, when combined with shock, indicates effusion into the peritoneal cavity.

Another symptom of importance is seen when the patient after twenty-four hours is getting worse instead of improving, and when slight rigidity of the abdominal muscles occurs in the ileocæcal region. If these three symptoms are all present, there is almost absolute certainty of perforation.

A third question of importance is whether we can in early cases *diagnose the presence of pus* and the formation of a local abscess. Talamon<sup>2</sup> considers it almost impossible during the first week. Hawkins<sup>3</sup> thinks that we must rest our diagnosis of pus upon the continuance or increase of symptoms at a time when in non-suppurative cases resolution should set in. The larger the indurated mass and the quicker it forms the greater the probability of pus. The indurated mass, however, may be lacking in cases in which the abscess is within the pelvis and beyond abdominal examination, although fever continues, or it may depend upon a thickened and adherent omentum. Neither is a continuous fever a sure sign, as it may depend upon pylethrombosis, liver-abscess, and other complications. One symptom, however, I believe, is always present where there is pus, even in early

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<sup>1</sup> Some Points on the Diagnosis of Appendicitis, Medical Record, January 6, 1894.

<sup>2</sup> Loc. cit., p. 173.

<sup>3</sup> Loc. cit., p. 85.

cases, and that is inflammatory leucocytosis with polynuclear cells. Exploratory puncture is hardly ever used. It is unnecessary when a large abscess is present, and dangerous when the abscess is small, as it leaves a track through which infection may take place.

#### DIFFERENTIAL DIAGNOSIS.

A number of different diseases, which may have one or more symptoms in common with appendicitis, may be mistaken for appendicitis. I shall mention the most common ones.

**Typhlitis Stercoralis.**—That typhlitis stercoralis exists has been shown both at autopsies and at operations, as severe forms of typhlitis and perityphlitis have been found to be dependent upon stercoral ulcers of the cæcum in cases where the appendix was normal. It can be recognized with certainty only by the initial presence of a doughy, sausage-shaped tumor in the cæcal region, associated with the usual symptoms of appendicitis in a modified form,—*i.e.*, less local tenderness and vomiting, constipation, and moderate fever. The tumor, however, at the very beginning of an attack of apparent appendicitis would justify the diagnosis of typhlitis stercoralis, and in the absence of that symptom it would be safer to consider it appendicitis.<sup>1</sup> Shrady,<sup>2</sup> who considers typhlitis quite common, mentions, as a frequent symptom, that indentation can be made in the tumor on account of its fecal contents. Kelynack,<sup>3</sup> too, considers it very common, particularly in people in feeble health and advanced in life; other authors find it especially in corpulent, sedate, elderly gentlemen.

<sup>1</sup> White, Therapeutic Gazette, June 15, 1894, p. 17.

<sup>2</sup> Medical Record, January 6, 1894.

<sup>3</sup> Loc. cit., p. 151.



I consider this disease much more common than is usually believed, and will here call attention to Renvers's<sup>1</sup> statistics from the German army, which probably have been looked upon by most surgeons with a great deal of scepticism. Renvers states that of two thousand cases of perityphilitis in the German army ninety-six per cent. recovered, and that of fifty-four cases observed by himself but three died. He thinks the majority of cases that present themselves to physicians are simply cases of typhlitis stercoralis, which leads to severe irritation in the surroundings of the cæcum and may produce phlegmonous inflammation with high fever and severe peritoneal symptoms. The etiology, he states, is constipation, and the examination reveals in the very beginning a considerable, easily felt swelling in the ileocæcal region, which may extend up above the anterior superior iliac spine. The fever, pain, and irritation disappear in a week and are followed by permanent recovery if we succeed in removing the fecal impaction. The majority recover by the use of purgatives or enemata, rest, and diet. This, he says, is the process in otherwise healthy individuals. It is not very remarkable that ninety-six per cent. recover from this complex of symptoms, which surely is that of fecal impaction and not that of appendicitis. The only thing remarkable is that these statistics have been quoted again and again as proof of the benign character of appendicitis, of the curative influence of medical treatment, and of the lack of necessity for operative proceedings. Only a small number of patients, he concludes, with diseases in the fossa iliaca dextra need surgical treatment. It is, in my opinion, not improbable that German soldiers, who march and exercise continually in heavy uniforms, perspiring profusely, and who live princi-

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<sup>1</sup> Deutsche Med. Wochenschrift, January 29, 1891.

pally on a diet of rye bread and sausage, should suffer from constipation and fecal impaction.

Vollert's<sup>1</sup> statistics from Nothnagel's clinic in Wien, of sixty-five cases with three deaths, point towards the same trouble. He advises against operation during the first few days, "as we meet many cases which commence with the most acute symptoms,—high fever, severe pains, and large tumor in the ileocæcal region,—all of which symptoms disappear under expectant treatment, if not on the second day, then after a few days." No surgeon would think of operating on such cases, and no surgeon believes that genuine cases of acute appendicitis recover under expectant treatment, "if not on the second day, then after a few days." Sahli does not believe in typhlitis stercoralis as a distinct disease. If it does exist, it plays only exceptionally a rôle in the production of perityphlitis. Operations show almost always that perityphlitis depends upon appendicitis, and the best thing a physician can do is to forget the name typhlitis stercoralis.

Diffuse peritonitis may result from the perforation of chronic gastric and duodenal ulcers, which frequently are latent, as well as perforating ulcers of the appendix, from typhoid and tuberculous ulcers, and occasionally from malignant diseases of the stomach and intestines.<sup>2</sup> The diagnosis may be difficult if diffuse peritonitis is already present when the patient comes under observation. The diagnosis depends upon a careful consideration of the previous history.

**Typhoid Fever.**—Suspicion of appendicitis is not at all uncommon in the first week of typhoid fever. The moderate fever with pain and tenderness in the iliac region and slight meteorism may suggest appendicitis. I have myself been

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<sup>1</sup> Deutsche Med. Wochenschrift, No. 33, 1891.

<sup>2</sup> Kelynack, loc. cit., p. 151.

called to operate for supposed appendicitis in two such cases. A careful study of the temperature, the previous history, and the general character of the disease will, however, clear up the diagnosis. Vidal's test may be of importance as a diagnostic means, also the absence of leucocytosis. Maizard<sup>1</sup> considers the abdominal resistance less marked, the local hyperæsthesia less pronounced, and the constitutional disturbances less alarming in typhoid fever than in appendicitis. Fitz<sup>2</sup> says that the symptoms in typhoid fever which suggest "a perforation of the bowel are those which in the absence of typhoid fever would be regarded as diagnostic of an appendicitis. The symptoms are not merely similar: they are identical." The symptoms of perforation in typhoid fever occur, however, rarely before the third week, and I should think it almost impossible at that time to make a wrong diagnosis between typhoid fever and a perityphlitic abscess of three weeks' duration.

**Intestinal Obstruction.**—This may depend upon many different pathological conditions, such as intussusception, volvulus, occlusions from adhesions and fibrinous bands, internal ruptures through tears in the mesentery, new growths, pressure from abdominal tumors, not to mention congenital malformations. Intestinal occlusion appears, however, with symptoms which in the main are the same as those of appendicitis,—*i.e.*, pain, vomiting, meteorism, and symptoms of diffuse peritonitis,—and it is not, therefore, remarkable that these cases now and then give occasion to wrong diagnoses. We will, nevertheless, discover essential differences when we analyze the symptoms. The pains are

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<sup>1</sup> Journal de Clinique et de Thérapeutique Infantiles, November 2, 1899.

<sup>2</sup> Transactions of the Association of American Physicians, vol. vi. p. 208.

most severe in the umbilical region or the region where the lesion is found, but they do not become localized in the ileo-cæcal region. Vomiting is constant and not intermittent, as in appendicitis, becomes quickly fecal, and is accompanied by obstinate constipation. Meteorism appears earlier and is more universal. Tenesmus and bloody diarrhœa will in some cases point towards volvulus, and rectal exploration may then be of importance. In intussusception the tumor can generally be recognized, oblong in shape and following the course of the colon, without marked local tenderness or increase of temperature. Adhesions and internal strangulations from fibrinous bands present generally a history of previous peritonitis. We shall, therefore, by a careful analysis of the symptoms, be able to arrive at a probable diagnosis. Exploratory laparotomy is indicated as a final resort and will clear up the diagnosis. MacDougall<sup>1</sup> considers the conditions alike, not so much in the beginning as when later peritonitis has appeared. Acute intestinal obstruction occurs usually in young adults, some of whom have suffered previous attacks of abdominal inflammation; constipation may precede both conditions and the histories may be alike, but the raised temperature, the continuous pain, the quickened pulse, the less urgent vomiting, the less absolute constipation, and the hard, board-like, tender belly point to the inflammatory process. Kümmell<sup>2</sup> considers the intestinal peristalsis in ileus the most important diagnostic symptom. In paralytic ileus from appendicitis there is a general extensive meteorism without any peristalsis and without prominent intestinal coils.

Affections of the gall-bladder have now and then been mistaken for appendicitis. A few years ago I operated on a

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<sup>1</sup> British Medical Journal, October 10, 1896.

<sup>2</sup> Berliner Klin. Wochenschrift, April 11, 1898.

patient for supposed chronic appendicitis. I found that the swelling depended upon a long, sausage-like gall-bladder which extended downward into the ileocæcal region and contained one hundred and twenty-six gall-stones. I, therefore, performed cholecystenterostomy with Murphy's button, which was discharged by the rectum on the twenty-third day. Perforation of the gall-bladder, too, may give symptoms not unlike those in certain forms of appendicitis.

The differential diagnosis between *appendicitis*, *gall-stone colic*, and *renal colic* may offer some difficulty, as they all give similar symptoms of pain, vomiting, and general ill-feeling. Fowler<sup>1</sup> gives the following table of differential diagnosis :

	APPENDICITIS.	GALL-STONE COLIC.	RENAL COLIC.
<i>Pain</i>	Around the umbilicus and epigastrium; does not radiate; the pains are fixed in the ileocæcal region.	In the epigastrium, radiating towards the shoulder and scapula; fixed pains in the region of the gall-bladder.	Radiates down in the inguinal region towards the testis and rectum, with tenesmus of the bladder and rectum.
<i>Tenderness</i>	In the ileocæcal region, over McBurney's point.	Over the gall-bladder.	Over the region of the kidneys.
<i>Vomiting</i>	Present in the beginning, but ceases then till later in the disease.	Frequent and continuous.	Rare except in the beginning.
<i>Bladder and Testicle</i>	Symptoms rarely present.	Symptoms absent.	Irritable bladder, with dysuria, tenesmus, and occasionally hæmaturia; testicle retracted.

**Movable Kidney.**—The symptoms of periodical hydro-nephrosis dependent upon prolapsed kidney may simulate those of appendicitis by the abdominal pain, chills, nausea, vomiting, and fever.<sup>2</sup> The cardinal symptoms of appendicitis are, however, absent, the tumor is movable and of the shape

<sup>1</sup> Annals of Surgery, February, 1894, p. 16.

<sup>2</sup> Osler, Principles and Practice of Medicine. New York, 1894, p. 720.

of the kidney, and may suddenly decrease in size contemporaneous with the discharge of a great deal of urine.

**Extra-Uterine Pregnancy.**—A patient entered the Sisters of Charity Hospital several years ago with the diagnosis of appendicitis. She was extremely weak, had a quick, small pulse, meteorism, and a hard, tender swelling in the right ileocæcal region. She had a waxy color, and was excessively anæmic; had not menstruated for two months. An exploratory laparotomy showed a ruptured tubal pregnancy on the right side and the pelvis filled with coagulated blood. W. T. Lusk<sup>1</sup> mentions a similar case. Symptoms of internal hemorrhage, with collapse, following cessation of menstruation and accompanied by symptoms of pregnancy, bloody vaginal discharge, and a tender and sensitive mass in the fornix vaginæ, point towards extra-uterine pregnancy.

**Acute Irritant Poisoning.**—Kelynack<sup>2</sup> mentions that the onset of perforative appendicitis may be so sudden as to suggest to the patient's friends the possibility of poisoning, the more so as the first severe symptoms may occur shortly after a full meal.

**Lead Colic.**—J. P. Lord<sup>3</sup> has published a case in which laparotomy was performed for supposed appendicitis. There were present constipation, constant vomiting, pain, tenderness near McBurney's point, board-like rigidity, and a doughy mass in the appendicular region. The appendix was somewhat thickened, but otherwise healthy, the cæcum distended and congested; the ileum and jejunum were contracted to the diameter of a little finger. Epsom salt was injected into the bowels through a trocar, and the patient began to improve when the bowels acted. It was then discovered that he had the well-marked blue line on the gums.

<sup>1</sup> Medical Record, December 5, 1896.

<sup>2</sup> Loc. cit.

<sup>3</sup> Journal of the American Medical Association, April 15, 1899.



Murphy<sup>1</sup> has published a similar case of intestinal obstruction due to lead-poisoning. Le Gendre<sup>2</sup> read a paper before the Société Médicale des Hôpitaux, on June 16, 1899, in which he points out that not only has lead colic been mistaken for appendicitis, but that appendicitis in the subjects of chronic plumbism has been mistaken for lead colic. He also brings forward evidence to show that lead colic may be followed by appendicitis and that the latter may be the result of plumbism, although, of course, lead colic and appendicitis may occur successively in the same subject. It is interesting to note that Haviland Hall reports a case of death in which he treated the patient—a painter—for lead colic. Necropsy showed perforative appendicitis.

**Coxitis**—Gibney<sup>3</sup> calls attention to the possibility of mistaking coxitis for appendicitis. I had one patient enter the hospital with the diagnosis of coxitis, on whom I operated for chronic appendicitis, with disappearance of all symptoms.

**Pyosalpinx**.—Hawkins<sup>4</sup> thinks it impossible in some cases to distinguish between an abscess of appendicular origin and one arising around a Fallopian tube, but, as an exploratory operation is necessary in both, he does not consider it of great moment. As a general rule, however, I should consider the differential diagnosis easy. Bimanual examinations will show a mass in the lateral regions of the fornix vaginae, the womb will be more or less immovable, and the whole history will be one of uterine troubles. H. V. Vineberg<sup>5</sup> thinks it next to impossible in catarrhal salpingitis to palpate a slightly thickened tube when the abdomen is rigid and ex-

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<sup>1</sup> Journal of the American Medical Association, January 4 and 11, 1896.

<sup>2</sup> The Lancet, July 29, 1899.

<sup>3</sup> American Journal of the Medical Sciences, January, 1881, p. 119.

<sup>4</sup> Loc. cit., p. 91.

<sup>5</sup> Medical Record, November 21, 1896, p. 738.

tremely sensitive. The following points he considers of importance for the diagnosis from acute appendicitis. In appendicitis the pain is frequently more excruciating than in salpingitis, is more likely to be limited to the abdomen, and does not usually radiate to such an extent as in salpingo-oophoritis. When the ovary is involved with the tube, as it frequently is, the pain commonly descends into the corresponding thigh. Gastric disturbances are common to both. In salpingitis the alarming symptoms usually subside to some extent in the course of three or four days, while in appendicitis they may continue or grow more severe. In doubtful cases examination under narcosis should be made.

G. R. Fowler<sup>1</sup> considers the diagnosis from diseases of the adnexa occasionally difficult because (1) the proximity of the appendix to the adnexa may confuse both objective and subjective symptoms, (2) because acute conditions of one and chronic conditions of the other may coincide, (3) because acute conditions of both may coexist, (4) because chronic conditions of both may coexist, and (5) because infectious inflammations of either may cause septic peritonitis, and septic peritonitis may hide the original trouble. The main points to be borne in mind are the following. Appendicitis is less frequent in the female than are diseases of the adnexa; in appendicitis the history is that of a condition coming on acutely; adnexal diseases are apt to show a record of a chronic condition, and are usually associated with menstrual disturbances. In both there may be acute and radiating or dull and localized pain; but acute radiating pain is the rule in appendicitis and dull localized pain in adnexal troubles. In either condition vomiting may be present, but it is far more frequent in appendicitis. The maximal point of ten-

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<sup>1</sup> Brooklyn Medical Journal, April, 1897.

derness in appendicitis is above the level of the anterior superior spinous process. Vaginal examination, if not forcible, rarely discovers tenderness in appendicitis, but develops tenderness in diseases of the adnexa, as do movements of the womb by the finger. A chill is usually absent in appendicitis, but is frequently present in adnexal diseases. Fever is generally present in appendicitis, but usually absent in adnexal diseases. Right-sided rigidity is almost invariably present in appendicitis, but rarely marked in tubo-ovarian diseases, unless complicated with considerable peritonitis. Tumor in appendicitis is rarely found before the third day, while in tubo-ovarian diseases it is likely to be found at the first examination. In appendicitis the tumor is usually located beneath the right rectus muscle, opposite the anterior superior iliac spine; in adnexal diseases it is more easily found by vaginal or bimanual examination, and may be missed entirely by abdominal palpation. The course of an appendicitis is that of an acute trouble, and even in chronic cases there is generally a history of at least one acute attack. In adnexal lesions the course is usually subacute or chronic from the beginning, save when complications intervene. Perforative peritonitis is more common from appendicular troubles than from diseases of the adnexa. Perforative peritonitis from appendicitis is almost always fatal, because very virulent organisms are set free in the peritoneal cavity; while perforative peritonitis from suppurative salpingitis is not nearly so fatal, for the reason that the micro-organisms are less virulent.

**Ureteritis.**—Deaver<sup>1</sup> calls attention to this lesion, which may complicate cystitis or tuberculosis and calcareous diseases of the kidney. The history, the presence of pus and blood in the urine, the pain and swelling discovered by

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<sup>1</sup> Loc. cit., p. 101.

rectal or vaginal examination of the ureter near its entrance into the bladder, and the lack of the cardinal symptoms of appendicitis will all help to clear up the diagnosis.

Deaver<sup>1</sup> mentions a number of other affections which might occasion a wrong diagnosis under certain circumstances. Psoas and lumbar abscesses would be distinguished by their tuberculous history, their slow growth, and the accompanying deformities; cancer of the cæcum, by the absence of inflammatory symptoms, the nodular swelling, the symptoms of cachexia, their appearance late in life, and their slow growth; tuberculosis peritonitis, by the history, by other tuberculous affections, early appearing ascites, hectic and night-sweats, etc. Obrastzoff<sup>2</sup> points out that in cancer we feel a circumscribed tumor only, but no bowel, while in tuberculosis we feel the bowel with thickened wall gradually extending into healthy bowel. I doubt this very much, as in cases of tuberculosis I have frequently been able to feel a circumscribed tumor only, and been inclined to consider it malignant. Heredity, course of the disease, and tuberculous bacilli in the dejections are of more importance for the diagnosis.

**Hysteria.**—Talamon<sup>3</sup> mentions several cases in which nothing was found at operation, in spite of predominant symptoms of appendicitis. Hysteria, according to him, may present two forms: (1) pseudo-appendicitis hysterica, with symptoms of an appendicular colic accompanied by vomiting, pains, and hyperæsthesia in the right hypochondrium, or with symptoms of a localized peritonitis with contraction of the right iliac muscle, which simulates a tumor; or (2) a real

<sup>1</sup> Loc. cit., pp. 104, 112.

<sup>2</sup> Archiv für Verdauungs Krankheiten, 1898, iv. 4, S. 440.

<sup>3</sup> Appendicite et péritonism hystérique, Médecine Moderne, 1897, p. 201.

appendicitis with hysterical tympanitis, which makes the attack appear dangerous.

### PROGNOSIS.

The prognosis is, at best, doubtful in acute cases, and depends in a predominant degree upon the treatment adopted. Under medical treatment the prognosis is, as Fowler<sup>1</sup> says, the more unfavorable the more serious the attack is, and under surgical treatment the more unfavorable the later the operation is performed. He observes, however, that many light cases undoubtedly recover, but adds also that many cases die which commence very mildly. There is a great discrepancy in the mortality-tables as furnished by physicians and surgeons. Physicians, to be sure, see many early cases recover, at least apparently, as we have no reliable statistics from their side in regard to relapses. They consider, therefore, appendicitis on the whole a benign disease. Surgeons, on the other hand, who see the severe and fatal cases, consider appendicitis one of the most dangerous and insidious of diseases, attended by a high mortality.

Von Bergmann<sup>2</sup> thinks that cases which recover by expectant treatment have been either cases of typhlitis or acute attacks of chronically inflamed appendices which do not go on to perforation. It is difficult or impossible to find the relative frequency of the mild and the severe cases. Talamon<sup>3</sup> thinks that half the cases belong to the mild forms, although he acknowledges that there are no authentic statistics, as these light cases are not ordinarily published, and that therefore only one kind of statistics will be of real

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<sup>1</sup> *Annals of Surgery*, March 1894, p. 327.

<sup>2</sup> *St. Petersburg Med. Wochenschrift*, 1892, No. 41, reported in *American Journal of the Medical Sciences*, 1893, p. 332.

<sup>3</sup> *Loc. cit.*, p. 137.

value,—viz., such as shall group together all the cases observed in a hospital in a certain number of years, with a full account of the mode of termination, of the complications, and of the treatment employed. Pepper<sup>1</sup> states that the affection certainly is a grave one, although probably the majority of cases (nineteen out of twenty) will recover, even without surgical treatment. It is dangerous, however, in every case, since there are no criteria by which we can predict whether the inflammation will be severe or light. The statistics from hospitals, however, do not agree. P. Guttmann<sup>2</sup> reports from the Moabit Hospital in Berlin ninety-six cases from 1879 to 1890. Only five of these patients died. In a few cases, he states, there were serious complications. The inference is, therefore, that the great majority were light forms. Fowler<sup>3</sup> observed in ten years at the Middlesex Hospital ninety-nine cases with a mortality of fifteen per cent. How many were cured permanently is not mentioned in the hospital reports, and this question is of the greatest importance. MacDougall<sup>4</sup> gives the mortality of one hundred and fifty cases during the last three years in Edinburgh Royal Infirmary at thirty-seven,—i.e., twenty-five per cent. In St. Bartholomew's and St. Thomas's Hospitals, for the years 1893 to 1895, we find two hundred and eight cases, of which thirty-nine died (nearly twenty per cent.), and this exclusive of the returns under "purulent peritonitis" and "peritonitis." Rotter<sup>5</sup> gives the statistics of two hundred and thirteen cases from St. Hedwig Hospital in Berlin, from 1893 to 1895, treated in the medical and surgical wards. Nine-

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<sup>1</sup> Text-book of the Principles and Practice of Medicine, Philadelphia, 1894, vol. ii. p. 823.

<sup>2</sup> Berliner Klinische Wochenschrift, March 16, 1891, S. 294.

<sup>3</sup> Quoted by Talamon, p. 138.

<sup>4</sup> Medical Record, August 29, 1896, p. 311.

<sup>5</sup> Über Perityphlitis, Berlin, 1896.



teen died, and the mortality was therefore of all cases eight and nine-tenths per cent. Twenty-one cases entered with diffuse peritonitis, and of these fourteen died,—a mortality of sixty-six per cent. In eight of these fourteen cases the disease commenced as a diffuse peritonitis and resulted fatally in spite of what Rotter considered a very early operation (from the third to the sixth day). In the other six fatal cases, in which the disease appeared as a more slowly progressing diffuse peritonitis, the operation was performed between the sixth and the twenty-third day. One hundred and ninety-two cases entered with “circumscribed perityphlitis,” of which one hundred and fifty-six (eighty-two per cent.) recovered under medical treatment, thirty-three were operated on with two deaths, and three died without operation. As Rotter, however, states that all cases in which either diffuse peritonitis or a localized abscess was present or developed were transferred to the surgical ward for operation, we may safely conclude that the great majority of his cases were light ones. Professor With’s<sup>1</sup> statistics from 1879 showed twelve deaths in thirty cases—*i.e.*, forty per cent. mortality—under more or less strict opium treatment. In later statistics of fifty cases he had under strict opium treatment a mortality of sixteen per cent. Floystrup’s<sup>2</sup> statistics of one hundred and fifty-six cases, treated from 1875 to 1887 in Professor Trier’s division in the Commune Hospital in Copenhagen, showed a mortality of fifteen and six-tenths per cent. under strict opium treatment, and Monrad’s<sup>3</sup> statistics showed thirty-three per cent. mortality in all cases under the same treatment. These statistics agree pretty well with those of other physicians. J. W. White<sup>4</sup>

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<sup>1</sup> See *Festskrifter ved Kjöbenhavns Universitet*, 1879.

<sup>2</sup> *Perityphlitis or dens Behandling Kjöbenhavn*, 1888.

<sup>3</sup> *Appendicitis hos Börn*, Kjöbenhavn, 1897.

<sup>4</sup> *Therapeutic Gazette*, June 15, 1894.

deplores the lack of reliable medical statistics, but believes the facts to be as follows: about eighty per cent. recover under medical treatment; of the remaining twenty per cent. at least one-half may be saved by operation during the condition of localized abscess, while of the other half, suffering from perforation with diffuse peritonitis, a certain proportion would recover by early operation. The mortality under strictly medical treatment would therefore be about twenty per cent., more or less, while by operating on the severe cases it would be reduced to five or eight per cent. As almost all authors agree that twenty per cent. of all cases are severe and eighty per cent. light, the conclusion necessarily is that almost every severe case dies under medical treatment. We cannot, however, either medically or surgically, consider all cases under one head and thus get a reliable result. If we consider them all under one head, we will arrive at just as wrong a result as if, for instance, we should compute the mortality of the radical hernia operation (Bassini) from all hernia operations. Supposing, among one hundred patients with hernia, we had twenty with strangulation and gangrene of the bowel, and these twenty all died after operation followed by a Bassini operation, then nobody would state the mortality of Bassini's operation to be twenty per cent.; but that is just what physicians are doing when computing the death from appendicitis. We must classify our cases and state the mortality in the different forms and under different treatment, medical or surgical. We must give the mortality under surgical and under medical treatment in the perforating cases with diffuse peritonitis, in the localized abscesses, in the gangrenous forms, in the chronic recurring forms, etc., besides mentioning the day of operation (if treated operatively), and we will get reliable statistics, convincing us of the utter worthlessness of any medical treatment in serious cases. The light cases will get well

under medical treatment, or, rather, in spite of medical treatment, by the healing power of nature.

Dr. Samuel Lloyd,<sup>1</sup> of New York, in order to compare conservative with operative treatment, has examined five hundred and fifty-eight cases, all serious enough to be published, and his conclusions are, to say the least, startling. Of the five hundred and fifty-eight patients, two hundred and sixty-three recovered and two hundred and ninety-five died, the mortality being fifty-three per cent. Two hundred and twenty-six were operated upon, of whom thirty-one died,—*i.e.*, a mortality of thirteen per cent.; while of two hundred and sixty-five patients who were treated conservatively, two hundred and five died,—*i.e.*, a mortality of seventy-seven per cent. Four hundred and forty-five of these five hundred and fifty-eight cases—*i.e.*, seventy-nine per cent.—resulted in abscess perforation or diffuse peritonitis. This, Dr. Lloyd says, is a dismal showing of conservative treatment. Dr. Wyeth<sup>2</sup> asks pointedly, in regard to these statistics, “whether any sane man would believe that such a mortality-rate would have occurred if these five hundred and fifty-eight cases had within the first twelve hours of the attack been turned over to a competent and conscientious surgeon. Under proper conditions, not fifteen of these five hundred and fifty-eight cases, instead of two hundred and ninety-five, would have died.” Lloyd believes that no case of appendicitis should be considered as purely medical.

Sahli,<sup>3</sup> on the other hand, reports seven thousand two hundred and thirteen cases from four hundred and sixty-six physicians; four hundred and seventy-three were operated on, with a mortality of twenty-one per cent., while six thou-

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<sup>1</sup> Proceedings of the Medical Association of Georgia, April 8, 1896, reported in Journal of the American Medical Association, May 2, 1896.

<sup>2</sup> Medical Record, May 9, 1896.

<sup>3</sup> Sahli, *loc. cit.*, p. 218.

sand seven hundred and forty were treated conservatively, with a mortality of eight and eight-tenths per cent. Relapses occurred in twenty and eight-tenths per cent. of four thousand five hundred and ninety-three cases. Sahli considers the high mortality in the operated cases the result of operating only in the severe cases and then often too late. Sonnenburg thinks these statistics prove that simple catarrhal appendicitis is much more frequent than usually supposed. *Under surgical treatment* the prognosis depends, in the acute perforative cases with local abscess or diffuse peritonitis, upon the *time of the operation*. The danger lies in the disease, not in the operation.

In regard to this point, interesting statistics of one hundred and twenty-seven cases have been furnished by Fowler.<sup>1</sup> Eighty-three per cent. recovered of fifty-eight cases operated on during the first three days; sixty per cent. recovered of nine cases operated on during the fourth day; fifty-eight per cent. recovered of twenty-six cases operated on from the fifth to the sixth day; fifty per cent. recovered of eighteen cases operated on from the seventh to the eighth day; thirty-three per cent. recovered of nine cases operated on from the ninth to the tenth day. This agrees with Murphy's statement that one-half of all patients who would have recovered by operation will die if we wait until the sixth day.

Of Fowler's fatal cases septic peritonitis was present in almost all at the time of the operation. Fitz<sup>2</sup> found that death in cases of perforative appendicitis occurred in eighty per cent. during the first five days; of one hundred and seventy-six cases sixty died during the first five days, forty-six during the first four days, twenty-eight during the first three days, and eight on the second day.

<sup>1</sup> Annals of Surgery, May, 1894, p. 565.

<sup>2</sup> Transactions of American Physicians, 1886, p. 126.

Porter<sup>1</sup> concludes from an examination of four hundred and forty-eight cases that there is less danger in deferring operation in recurrent than in primary cases,—a point on which all surgeons will agree. Kümmell<sup>2</sup> found the greater mortality during the first attack. Among twenty-five fatal cases seventeen died during the first attack, five during the second, one during the third, and two after many attacks. Among twenty-eight fatal cases of diffuse peritonitis in my own practice seventeen had never had an attack before, three had had one attack, three two, two three, and three many attacks. Porter considers two facts as settled: *first*, when an operation is to be made, the earlier it is done the better the chances of recovery; and, *second*, that the character of the attack and the consequent condition of the patient, and not the number of hours and days of illness, should form the basis of decision as to the proper time for operation. His statistics of four hundred and forty-eight cases, however, do not give any reliable information, and are positively misleading. They are as follows:

Whole number of cases . . . . .	448
Whole number of recoveries . . . . .	371
Whole number of deaths . . . . .	77
Average mortality, 17.23 per cent.	

1. Removal of appendix during attack, one hundred and fifty-one cases.

Recovered . . . . .	122,— <i>i.e.</i> , 80.3 per cent.
Died . . . . .	29,— <i>i.e.</i> , 19.7 per cent.

2. Removal of appendix during quiescence, fourteen cases.

Recovered . . . . .	13,— <i>i.e.</i> , 92.86 per cent.
Died . . . . .	1,— <i>i.e.</i> , 7.14 per cent.

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<sup>1</sup> American Journal of the Medical Sciences, 1893, p. 649.

<sup>2</sup> Berliner Klinische Wochenschrift, April 11, 1898.

3. Incision and drainage of abscess, one hundred and eighty-eight cases.

Recovered . . . . .	154,— <i>i.e.</i> , 81.82 per cent.
Died . . . . .	34,— <i>i.e.</i> , 18.18 per cent.

4. Appendicitis without operation, ninety-five cases.

Recovered . . . . .	82,— <i>i.e.</i> , 86.32 per cent.
Died . . . . .	13,— <i>i.e.</i> , 13.62 per cent.

We must know, in order to form an intelligent opinion in regard to division No. 1, the condition of the appendix, whether diffuse peritonitis was present or not, the day of the disease on which the operation was performed, etc. It is, in regard to division No. 2, absurd to state that the mortality in operations during the quiescent period is 7.14 per cent.: the numbers are all too small to form an opinion, and we have so many other statistics of operations during this period showing that the mortality, if not nothing, is next to nothing. Bull,<sup>1</sup> for instance, gives statistics of four hundred and forty-two cases with eight deaths,—*i.e.*, one and four-fifths per cent. mortality; Morris<sup>2</sup> operated on fifty-nine patients, and they all recovered; Treves<sup>3</sup> had thirty-two cases with one death from other causes than peritonitis, and he has since reported one hundred and fifty operations without a death. Lennander<sup>4</sup> had twenty-one cases which all recovered, Richardson<sup>5</sup> two hundred and thirty-eight operations without a death, and I have had sixty-six operations with two deaths from other causes than peritonitis and one death from shock the result of the operation. We hear the

<sup>1</sup> Medical Record, 1894.

<sup>2</sup> Loc. cit., p. 81.

<sup>3</sup> British Medical Journal, March, 9, 1895, p. 577.

<sup>4</sup> Loc. cit., p. 115.

<sup>5</sup> Loc. cit.



same result from all other surgeons. The mortality, if not nothing, is next to nothing. When an operation in the interval is performed on a patient who has had many attacks, and when there are numerous adhesions and considerable broken-down tissue, there is occasionally a death. No surgeon will agree to the statement, in regard to division No. 3, that the mortality after incising and draining the abscess is 18.18 per cent. It depends altogether upon how long the abscess has been allowed to progress, and even then the mortality depends upon complications, such as perforation into the abdominal cavity, septicæmia, pylephlebitis, obstruction, etc. There are but few statistics, except in earlier literature, as we do not allow the cases to progress, but operate on them early. These cases are now treated by early laparotomy and with almost unfailing success. As regards No. 4 we lack all information concerning the character of the cases treated without operation. If severe, the mortality is too small; if mild, too high. We lack, besides, all information whether there were any relapses during the next few years, about their frequency, character, and mortality.

The mortality under surgical treatment depends almost absolutely on the *number of cases with gangrene, perforation, and diffuse peritonitis*. Wyeth<sup>1</sup> computes the mortality from three hundred and sixty-four cases operated on at eighteen per cent., Murphy<sup>2</sup> at nine and six-tenths per cent. from one hundred and ninety-four cases operated on by himself, Morris<sup>3</sup> at seven per cent. from one hundred personally operated cases, but only ten of these were cases of diffuse peritonitis. Only three of these ten cases died, probably on account of the thoroughness with which he washed out and drained the peritoneal cavity. He reports other statistics of one hundred

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<sup>1</sup> Loc. cit.

<sup>2</sup> Medical News, January 5, 1895.

<sup>3</sup> Lectures on Appendicitis, New York, 1895, p. 81.

cases with two per cent. mortality;<sup>1</sup> thirty-four cases were acute forms with abscess, four chronic forms with abscess, twelve acute forms without abscess, forty chronic forms without abscess, and the rest tuberculosis and cancer. Fowler had thirty-two cases with gangrene, perforation, and diffuse peritonitis, and they all died; Fenger, in Chicago, had eleven cases, of which one recovered; I have had eighty-one cases, of which thirty died and fifty-one recovered. These fifty-one cases were all operated on early, on the second or third day, and in thirty-two of them I found the appendix more or less gangrenous without limiting adhesions, while perforation and peritonitis were present in nineteen. Who can doubt that these thirty-two patients would all have died under any other treatment, and that they were saved only by the prompt and early operation before perforation had occurred? McBurney<sup>2</sup> had fourteen recoveries and ten deaths in twenty-four cases (*i.e.*, forty per cent. mortality); Willy Meyer<sup>3</sup> saved three out of four, if operated on inside of twelve hours, while all died if operated on later; Richardson had nine recoveries in thirty-two cases (*i.e.*, seventy-five per cent. mortality); Mikulicz had two recoveries in eleven cases; Sonnenburg<sup>4</sup> twenty-seven recoveries in sixty-four cases.

It is, at least in America, recognized that there is scarcely any danger in an early laparotomy. It is pertinent, therefore, to ask, *whether the death-rate would increase or diminish if every case were operated on as soon as diagnosed.* White<sup>5</sup> believes that by surgical treatment in all early cases there would be an extremely low mortality, but not that it would be practically nothing. Hawkins<sup>6</sup> considers the claims of surgeons

<sup>1</sup> Medical Record, February 15, 1895.

<sup>2</sup> Ibid., March 30, 1895.

<sup>3</sup> Ibid., February 9, 1896.

<sup>4</sup> Centralblatt für Chirurgie, July 16, 1898.

<sup>5</sup> Loc. cit.

<sup>6</sup> Loc. cit., p. 128.

fairly,—with greater fairness than I have found elsewhere. In regard to the assertion of surgeons, that by early operation many lives will be saved, he acknowledges that thirteen per cent. of all cases develop diffuse peritonitis ; but in order to save these thirteen lives one hundred successful laparotomies must be performed, which he scarcely considers probable. We meet, besides, certain forms with large perforations, accompanied by the passage of fecal matter and bacteria into the abdomen, and he doubts whether operation would be of any avail in such cases, although there is good reason to believe that those cases of diffuse peritonitis which commence as a local form, and those which, commencing mildly, suddenly collapse and die on the fourth or fifth day from lymphangitis, would recover by operation. He thinks, therefore, that by early routine operation some lives might be saved, but not enough to counterbalance the disadvantage of such wholesale surgery. He forgets, however, that the diagnosis of the severe cases, as I have already pointed out, is not so difficult as supposed ; that there are certain serious symptoms, particularly the severe pain, the muscular rigidity, the lack of improvement inside of twenty-four or thirty-six hours, and the condition of the pulse, which ought to put the physician on his guard and impel him to have his thirteen patients operated on before it is too late. With those safely disposed of, the question is how great the mortality would be in eighty-seven simple, uncomplicated, early laparotomies. All competent surgeons agree that in these cases the mortality is very small, scarcely more than in the quiescent period. In regard to the assertion of surgeons that much suffering will be avoided by the prevention of future attacks, he concludes that if all his relapsing cases (fifty-nine) had been operated on after the first attack seven lives would have been saved and fifty-two other individuals would have been spared a more or less severe illness, provided these fifty-nine early

laparotomies had terminated favorably, which he, in this case, considers probable. *The logical conclusion*, therefore, it seems to me, is that under medical treatment those cases (about eighty per cent.) will recover which simply suffer from mild attacks, and for that matter need no other treatment than rest in bed, diet, and perhaps a little opium, while the serious cases, with gangrene and perforation with diffuse peritonitis, almost invariably will die, and that a certain percentage of those with localized abscesses will recover by perforation into the bowels, but independently of the medical treatment used. "No purely medical treatment of actual value in preventing or controlling the disease has yet been presented to the profession."<sup>1</sup> Under surgical treatment the perforative cases have a fair chance of recovery, the chance depending absolutely on the time of operation and being less and less for each day the operation is put off. "The chief cause of death in appendix operations is delay. If a death is due to general septic peritonitis, it occurs at a late period of the attack, and if there had been no delay there would have been no septic peritonitis."<sup>2</sup> The cases with localized abscess recover almost invariably by early operation; the chronic recurring cases in the quiescent period have no mortality worth mentioning; the mild cases may show a certain mortality by operation, but it will at least be very small and by far counterbalance the fatal cases and the sufferings which will result from recurring attacks in the eighty per cent. which recovered apparently after medical treatment.

Under medical treatment there is a sure mortality of probably sixteen per cent., more or less, in all cases; under sur-

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<sup>1</sup> McBurney, Dennis's System of Surgery, vol. iv. p. 415, New York, 1896.

<sup>2</sup> McBurney, New York Polyclinic, January 15, 1897.

gical treatment there may be a small mortality, probably less than four per cent. in early operations, and then in cases with primary large perforations, while relapses are impossible. The relapses in the apparently recovered eighty per cent. of medical cases will during the next few years probably bring the mortality higher than sixteen per cent., not counting the suffering and the loss of time dependent upon these relapses.

“Whatever we do, the responsibility is considerable at best, but the responsibility is a hundredfold greater when we advise delay in resorting to operation.”<sup>1</sup> “To be positive in regard to many points of the utmost importance we must wait. If we wait long enough, say to the seventh or ninth day, many of these difficult questions will be solved, for one after another of our patients will have died and one after another of our questions will have been answered.”<sup>2</sup> “The rule that needs to be constantly repeated is the one that calls for the surgeon early in the disease. It cannot be repeated too often. The rule that requires an invariable course of procedure in appendicitis, without regard to the special aspects of the case, to the constitutional peculiarities of the patient, to his surroundings, to the fitness and experience of the operator, is a rule which is justified neither by facts, theories, nor arguments.”<sup>3</sup> One question, however, has not been settled, although of the greatest importance, both in regard to prognosis and treatment,—viz., *whether complete recovery occurs after a bona fide attack of appendicitis*. Professor With<sup>4</sup> stated that seventy per cent. never get more than one attack; Hawkins<sup>5</sup> had fifty-nine relapses in two

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<sup>1</sup> Rushmore, *Annals of Surgery*, October, 1896.

<sup>2</sup> McBurney, *Ibid.*, April, 1891, p. 243.

<sup>3</sup> Richardson, *loc. cit.*

<sup>4</sup> *Forhandlinger of Kjöbenhavn Med. Selskab*, 20 Januar, 1891.

<sup>5</sup> *Loc. cit.*, p. 112.

hundred and fifty cases,—*i.e.*, twenty-three and six-tenths per cent. ; Fitz<sup>1</sup> had forty-four per cent. relapses ; I have had forty-seven per cent. relapses.

Porter<sup>2</sup> says that, taking all the facts as given on the subject of recurrence, we “ must conclude that the large majority of cases are solitary, though we are not warranted in making a positive statement as to the exact percentage.” It must, however, be remembered that very mild forms of appendicitis may be overlooked or forgotten by the patients, although they may leave behind pathological changes which directly may lead to relapses ; neither is it probable, with our present knowledge of the etiology and pathology of appendicitis, that the disease would start spontaneously. My personal opinion (and it is shared by a great many distinguished surgeons) is that perfect recovery, except after obliteration or destruction of the appendix, never occurs except, perhaps, in the earliest and mildest forms, which cannot be diagnosed clinically, but that strictures, with subsequent retention of secretion and formation of concrements, dilatations, infiltration, stiffness of the organ, deformities, and adhesions, will be found as the result of every tolerably acute attack, and that these pathological conditions form the predisposing cause to new attacks, the intensity of which again depends upon the presence of pyogenic microbes. The frequency with which we, by Edebohls’s method of palpation, find thickened, stiff, and tender appendices in people who formerly have had one or more attacks of even mild appendicitis speaks against the occurrence of perfect recovery. So does the frequency with which pathological lesions are found at autopsies. I am convinced that we may show after every acute attack of appendicitis that the appendix is no longer normal, but in a more or less

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<sup>1</sup> Boston Medical and Surgical Journal, June 19, 1890, p. 650.

<sup>2</sup> American Journal of the Medical Sciences, 1893, p. 650.



pathological condition and inclined to be attacked again,—an attack which perhaps may be slight and disappear again, but which also may be one of the most serious ones, with gangrene, perforation, and diffuse septic peritonitis. Willy Meyer<sup>1</sup> holds that an appendix which has been inflamed once, seriously or mildly, must be looked upon as a diseased organ which is apt to give rise to serious trouble at some time in the future, and, therefore, as a prophylactic measure, should be removed after the first attack. He is convinced that not twenty nor even ten per cent. of them will be found to remain healthy. McBurney<sup>2</sup> has no doubt that the large majority continue to suffer after an apparent recovery, and present symptoms of a chronic appendicitis. Professor Dieulafoy<sup>3</sup> takes virtually the same position when he states that in all cases of appendicitis there is obliteration of the appendicular canal, and that the appendix is converted into a closed sac. Sonnenburg<sup>4</sup> warns against laying too much weight on physicians' statements about spontaneous cures or on their published statements about the percentage of recoveries, as they give no information about relapses. We operate often on cases which were discharged from medical wards as recovered from the first attack. Samuel Lloyd<sup>5</sup> reports the final results of twenty-five cases which had all been treated conservatively during their first attack and pronounced cured. Of the twenty-five cases six terminated fatally (twenty-four per cent.), three of which were operated on too late to save them and three died from perforation and peritonitis without operation. Eighteen cases had re-

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<sup>1</sup> Medical Record, February 29, 1896.

<sup>2</sup> Annals of Surgery, June, 1896.

<sup>3</sup> Report of the Meeting of the Academy of Medicine in Paris, March 10, 1896.

<sup>4</sup> Deutsche Zeitschrift für Chirurgie, 1891, Band xxxviii. S. 163.

<sup>5</sup> Medical Record, February 10, 1900.

currences, seven none. The recurrences showed a gradual tendency to increase in frequency and severity. Fifteen cases were ultimately operated upon with three deaths from too late operations. Ten were not operated on, three of which died from perforation and peritonitis. Kümmell<sup>1</sup> reports a series of one hundred and four cases of recurring appendicitis, all operated upon and all recovering. In not one case had the appendix become normal after the first attack, and inflammatory conditions were present in all. The patients, although discharged as cured after their first attack, were in reality not cured. Czerny<sup>2</sup> opposes Sahli's conclusion that ninety-two per cent. recover by conservative treatment, and states that these ninety-two per cent. do not represent recovered cases. All kinds of digestive disturbances are left behind, which may lead to a fatal issue, such as intestinal obstructions, adhesions to the vena porta, colon, or gall-bladder, diarrhoea or constipation or fecal impaction.

Spontaneous cure may occur by obliteration of the appendix, or after perforation of an abscess and destruction of the appendix, and in rare cases by absorption or incapsulation of a small abscess, but relapse will occur, if the spontaneous cure is imperfect, after months or years,—even after twenty years. Deaver<sup>3</sup> says that the proportion of persons who have but one attack and remain perfectly healthy after its subsidence is so infinitely small compared with those who have repeated attacks with an interval of invalidism, that, where practicable, all cases of appendicitis should be operated on as soon as the diagnosis has been established. Hel-

<sup>1</sup> Berliner Klinische Wochenschrift, April 11, 1898.

<sup>2</sup> Beiträge zur Klinischen Chirurgie, Tübingen, 1898, Band xxi. S. 517.

<sup>3</sup> Loc. cit., p. 123.

ferich,<sup>1</sup> of Greifswald, believes that smaller abscesses may become reabsorbed or incapsulated, but that this does not constitute a perfect recovery unless obliteration of the appendix or *restitutio ad integrum* occur.

Krafft<sup>2</sup> thinks resolution impossible, and believes that there is always a pus focus left which, on slight provocation, may start the inflammation again. Max Schede<sup>3</sup> says that relapses are frequent in the simple acute forms, and that eventually the more severe forms will occur. Lennander<sup>4</sup> met relapses in every case, when observed long enough, in which resistance and tenderness continued in spite of medical treatment. White<sup>5</sup> refers to the statement of Fitz, that, while a simple catarrhal appendicitis may exist anatomically, it is doubtful whether its clinical appreciation is possible. The same symptoms that indicate a slight catarrhal appendicitis from mechanical obstruction—*i.e.*, colicky pains, local tenderness, moderate fever, rigidity, and vomiting—may be found in cases which are going on to rapid termination by gangrene, perforation, and septic peritonitis.

“It must, therefore, be decided,” White states, “whether medical treatment or operation offers the best chance for recovery in these cases, and in reaching this decision it is impossible to ignore the oft-repeated assertion, that all cases are essentially infectious, and that recovery from any particular attack is, as a rule, only apparent and temporary, not real and permanent.” Hawkins,<sup>6</sup> although a strong conservative, thinks that every patient who has once had an attack of perityphlitis is liable to a second attack as long as

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<sup>1</sup> Die Pathologie und Therapie der Typhliden, see Verhandlungen des 13 Congresses für Innere Medicin, München, 1895, S. 246.

<sup>2</sup> Volkmann's Klinische Vorträge, January, 1889.

<sup>3</sup> Die Chirurgische Behandlung der Perityphlitis, Deutsche Med. Wochenschrift, No. 23, 1892.

<sup>4</sup> Loc. cit., p. 42.

<sup>5</sup> Loc. cit.

<sup>6</sup> Loc. cit., p. 111.

his appendix remains unobliterated or until it is removed. I might multiply these statements, but I consider the references mentioned sufficient to prove the doubt about perfect recovery after an acute attack which is held by those best able to judge,—the operating surgeons.

### TREATMENT.

I have in the preceding pages stated my opinion, based upon different statistics, that strict medical treatment has a mortality primarily of probably twenty per cent., and that about eighty per cent. recover. I have also expressed my conviction, shared by many surgeons, that all these recoveries are more or less fictitious. They are subject to the same rules as other cases, and will probably be followed by relapses in from twenty-five to fifty per cent., of which a certain number will die during the second attack, another portion during the third attack, etc., bringing the mortality of a given one hundred cases under medical treatment considerably higher than twenty per cent. Moulin<sup>1</sup> says that, excluding the very mild cases, relapses probably occur in about sixty per cent. of the non-operated cases. Placing it at fifty per cent. only, the matter stands thus: taking one hundred ordinary hospital cases, twenty-eight will suffer from local and diffuse suppuration and be operated on. Of the seventy-two remaining, thirty-six will suffer from one or more relapses, in each of which they will incur the same risk again and each of which will confine them to bed for twenty-five days. H. A. Caley<sup>2</sup> also remarks that general statistics giving the mortality of appendicitis in the aggregate are misleading unless based upon a large series of cases including all forms. "Of more importance than the mortality of appendicitis in

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<sup>1</sup> The Lancet, December 16, 1899.

<sup>2</sup> Ibid., December 2, 1899.

the aggregate is the relative danger to life in the several forms of the disease." I have also shown that by early operative treatment the twenty per cent. fatal cases under medical treatment will recover, save possibly a few in which there is a large perforation in direct communication with the cæcum, and that the result depends upon the time of operation, the danger and the mortality increasing with each day the operation is delayed. If the eighty per cent. of apparently recovered cases were submitted to operation, either during the mild attack or else after recovery or in the quiescent period, there is scarcely any doubt that the mortality, in the hands of a careful and conscientious surgeon, would be, if not nothing, next to nothing, leaving the mortality under surgical treatment probably less than five per cent., with no chance of relapses in the remaining cases. With these statistics in view, it is of interest in the following pages to review the opinions of prominent physicians and surgeons in different countries and thereafter to consider the medical and surgical treatment proper.

In England we still find rather conservative ideas prevailing, supported principally on the strong protests of Treves<sup>1</sup> against wholesale operations in all cases of typhlitis, even if they are distinctly acute, as the majority terminate in recovery under medical treatment. He considers surgical treatment called for only in comparatively few, selected cases, and even in these it is possible to clamor for too early operation. "The almost reckless and injudicious manner in which the appendix is being excised at the present day is doing a great deal to bring the operation into discredit." Treves has confined himself almost exclusively to operations in the quiescent period, he having performed thirty-two operations with one death, this not being due to

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<sup>1</sup> Lancet, February 21, 1891.

peritonitis. In a later paper<sup>1</sup> he continues to condemn in the strongest terms those who operate as soon as the diagnosis is made, and insists that operation rarely is necessary before the fifth day. Still, he acknowledges that violent cases exist which produce death in forty-eight hours, but he believes that they are exceedingly rare and easily recognized. In such cases, of course, operation cannot be done at too early a period. Treves seems, nevertheless, to have considerably modified his opposition to radical measures, as he says that operation should at once be undertaken if there is a strong suspicion of pus and if swelling continues to increase without abatement of the fever. These statements do not seem to harmonize with his previous assertion that operation is rarely necessary before the fifth day. He advises against prolonged search for the appendix, as the cases in which the least is done do the best. If the incision should open the peritoneum, he advises to close it and incise again at a point at which the pus can be reached within the area of adhesions. Such a rule may be good practice when we wait till the fifth day or later. Treves evidently yet believes in the obsolete extraperitoneal operation. He still confines himself to operations in the interval, of which he since has performed one hundred and fifty without a death. In 1893 Kelynack,<sup>2</sup> speaking from a pathologist's point of view, acknowledges that in certain forms of appendicitis operation is the only measure that can avert a fatal termination :

1. All cases of acute perforative appendicitis with diffuse peritonitis. Here laparotomy gives the only chance, and the earlier it is performed the better.

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<sup>1</sup> British Medical Journal, October 31, 1896.

<sup>2</sup> Contributions to the Pathology of the Vermiform Appendix, London, 1893, p. 157.



2. Cases of perforative appendicitis with localized abscess, as there is the possibility of sudden irruption into the peritoneal cavity with fatal results.

3. In rapidly progressing cases, quickly leading to gangrene, in order to forestall the perforation.

4. In cases of recurrent or relapsing appendicitis in which the attacks are so severe or so frequent as seriously to interfere with the duties of the patient.

One wonders which cases he would leave to medical treatment and what he means when he says,<sup>1</sup> "that the all-important practical classification must ever be (1) operative appendicitis and (2) non-operative appendicitis."

Hawkins,<sup>2</sup> in 1895, tried honestly and fairly to solve the difficult question by the aid of statistics, working, however, with small numbers. His conclusions from two hundred and sixty-four patients are that if all his relapsing cases (fifty-nine) had been operated on during or immediately after the first attack seven lives would have been saved and fifty-two other individuals would have been spared a more or less severe illness, provided, of course, that these fifty-nine early laparotomies had terminated favorably. "If, however, the mortality of the operations is so small that it may be neglected, and if I am wrong in doubting its efficacy in preventing fatal peritonitis, it must then be admitted that excision in the first two days of illness is the true and rational plan of treatment." Hawkins, I believe, makes one great mistake in considering seventy-eight per cent. perfectly recovered. Many of them will, without doubt, suffer relapses, increasing his mortality considerably.

He bases his opinion, as stated, on two hundred and sixty-four cases from St. Thomas's Hospital with a mortality of

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<sup>1</sup> Loc. cit., p. 159.

<sup>2</sup> Diseases of the Vermiform Appendix, London, 1895.

fourteen per cent.<sup>1</sup> This mortality agrees well with Professor With's and Dr. Floystrup's mortality of respectively sixteen and fifteen and four-tenths per cent. under exclusive opium treatment, as operations were confined to opening thirty-three cases of abscess, making laparotomy in eleven cases of diffuse peritonitis, all of which died, besides removing the appendix in one case of simple perityphlitis without pus. One hundred and ninety of the two hundred and sixty-four cases had simple adhesive appendicitis limited to the right iliac region and not progressing to the formation of pus. They all recovered, and counting these cases is what makes the mortality so low,—*i.e.*, fourteen per cent. These cases would recover under any treatment, medical or surgical. It is, however, a question—and a very important one—in how many cases the recovery was perfect and permanent. Forty-five of these one hundred and ninety cases—*i.e.*, twenty-four per cent.—had had one or more previous attacks; but, nevertheless, the recovery was perfect! In thirty-eight cases the disease progressed to formation of pus, ten of which died,—*i.e.*, twenty-six per cent. mortality. Seven had had previous attacks, four of which died. This is a very high mortality, and does not compare at all favorably with the results obtained by American surgeons in this class of cases.

Diffuse peritonitis was present in thirty-eight cases, in four of which the peritonitis was localized at first, and the mortality was twenty-seven,—*i.e.*, seventy-seven per cent.; seven had had previous attacks, of which four died. Taking all his cases together in which there was formation of pus, localized or diffused, we find a mortality of thirty-seven in seventy-four cases,—*i.e.*, fifty per cent.; and we may, perhaps, take Hawkins at his word and consider this the result “of allowing the disease to take its natural course.” While he

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<sup>1</sup> Loc. cit., p. 127.

is conservative in the acute and perforative cases, in spite of his conclusions, he is in favor of excising the appendix in the quiescent period, and considers it a better method than excision during the first attack, although acknowledging the difficulty in arriving at a definite practice, "as no man by any known symptom can prophesy as to the occurrence of future attacks." It may be accepted, he states, that the odds against a subsequent attack are as three to one (Fitz says five to two), and the odds against its terminating fatally as seven to one. He thinks it, therefore, the duty of the physician to advise the removal of the appendix after the first attack, on the ground of preventing the slight loss of life and the immense waste of time that is associated with a recurrence of attacks.<sup>1</sup>

It is rather discouraging, after the clear and comprehensive pathological exposition in the works of Kelynack and Hawkins, to turn to the addresses in medicine and surgery at the meeting of the British Medical Association, at Carlisle, July 28, 1896.<sup>2</sup> Sir Dyce Duckworth, in his address in medicine, states that many cases recover under judicious medical treatment; that a perityphlitic abscess, if opened carefully about the ninth or tenth day and without contaminating the peritoneal cavity, will generally heal favorably; that earlier surgical interference is very apt to lead to a fatal issue by toxic peritonitis; and that only a gangrenous state of the appendix, if diagnosed early, demands an early operation. Dr. MacLaren, delivering the address in surgery, expresses probably the conservative English opinion, that only after repeated attacks and failure of careful dieting are we justified in resorting to a preventive operation. The great majority of attacks, he argues, are not repeated, everything clears up

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<sup>1</sup> Loc. cit., p. 132.

<sup>2</sup> British Medical Journal, August 1, 1896, pp. 255 and 262.

after one attack, perforation occurs in most instances in the first attack, and one attack does not increase the probability of perforation in recurrence. The time for preventive operation comes after relapse, not after the first attack, and it is then devoid of danger and absolutely effective. The discussion, however, showed that English surgeons are commencing to distrust the conservative treatment advocated by Treves and other leading men. Mr. Rutherford Morison, for instance, would operate after the second attack in cases of abscess, in cases of perforation, and in cases with sudden onset of urgent symptoms in quiescent cases. Mr. Morton, of Bristol, would operate in every severe case, for fear of peritonitis. Mr. Verrall, in comparing Hawkins's statistics with those of Murphy, of Chicago, thought that early operation lowered the mortality and saved time and pain.

Since that time opinion seems to have changed considerably in favor of surgical treatment. The medical journals are full of reports of operated acute cases, the different medical societies have discussed the subject, and conservative methods seem to be more and more distrusted by many surgeons. In the discussion of a paper by Treves (October 31, 1896), MacDougall thought it but fair "to refer to the great work American surgeons have done in this field, and it is impossible not to admit that by drawing attention to the fatality of the diseases of the appendix they have given a valuable impulse to its recognition and its treatment." Jordan Lloyd expressed the opinion that "in acute cases of general peritonitis immediate operation gave the only chance." Mitchell Banks remarked "that ere long we shall hear no more of those foudroyant cases of so-called general suppurative peritonitis which are almost always fatal, seeing that there is little doubt that the great bulk of these terrible catastrophes are due to intraperitoneal appendiceal abscesses which burst their retaining barriers of lymph and fill the general peritoneal

cavity with a rush of stinking, putrid pus. They will in the future be promptly treated and with excellent hope of cure." Pearce Gould<sup>1</sup> urges the importance of early diagnosis and demonstrates the hopefulness of immediate operation. He thinks the statement of Hawkins, that operation for general peritonitis is uniformly unsuccessful, requires qualification, and is true only in those cases which have been allowed to run on for several days. He reports twelve cases of acute general peritonitis, all of which were operated upon, with seven recoveries. Brown<sup>2</sup> reports thirteen cases operated on for diffuse peritonitis, with three deaths, and Horatio Symonds<sup>3</sup> six successful cases of laparotomy for appendicitis. The cardinal point, in his opinion, is never to delay operation an hour longer than is absolutely necessary. Mansell Moulin,<sup>4</sup> in a paper on "Early *versus* Late Operations in Cases of Inflamed Appendix," compares the American method of operation (within thirty-six hours) with the English idea that, unless the symptoms are so imperative that delay is out of the question, it is better to wait at least until the fifth day. Both of these views, he says, cannot be correct. If it is right to wait until the fifth day in all but absolutely imperative cases, it is wrong to make a rule of operating at the end of thirty-six hours, and *vice versa*. The opponents of early operations maintain that such a number of operations are unnecessary. To this Mansell Moulin replies that the statement that the operations are unnecessary is merely an assumption. It is easy to be wise after the event, and to point out after the patient has recovered that an operation was unnecessary; but the question has to be settled in each individual case at the beginning of the attack, when it is impossible to tell what may happen. No one can predict the result of an inflammation of the ap-

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<sup>1</sup> The Lancet, January 1, 1898.

<sup>2</sup> Ibid., March 13, 1899.

<sup>3</sup> Ibid., July 29, 1899.

<sup>4</sup> Ibid., December 16, 1899.

pendix. The question, therefore, whether operation is unnecessary or not, must be answered at a time when the issue of the disease cannot be foretold. Moulin has come to the conclusion that the American method is the correct one, and he advocates operation at the earliest possible opportunity in all cases which have not shown definite signs of improvement within thirty-six hours.

Germany.—I have in a previous section referred to Rensers's statistics of two thousand cases from the German army, with ninety-six per cent. of recoveries, and to Vollert's report, from Nothnagel's clinic in Vienna, of sixty-five cases, with ninety-five and four-tenths per cent. of recoveries, and shown that these statistics are of no value, as they largely consist of typhlitis stercoralis, give no idea about relapses, and are completely at variance with the results of medical treatment from all other sources. The Germans, however, continue largely to hold conservative views and to oppose early operations. Ewald<sup>1</sup> says that as from ninety to ninety-one per cent. of all cases recover without an operation, it "would smack of insanity to subject every case to the uncertainties of an operation. That perityphlitis belongs to the surgeon has never received the assent of the general practitioner, and never will." His main treatment is opium, and the pain gives the best criterion as to when and how much opium should be given. He advises operation, however, in cases in which perforation, followed by general peritonitis, has occurred; in cases with abscess formation, with symptoms of constitutional disturbances or septic infection, particularly if the pulse be high; in cases of recurrent attacks of increasing severity and frequency; and in chronic cases in which a swollen appendix can be palpated. Herzog's<sup>2</sup>

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<sup>1</sup> Twentieth Century Practice of Medicine, vol. ix. p. 170.

<sup>2</sup> Zeitschrift für Klinische Medicin, 1899, Band xxxvi. S. 247.



treatment also is that of opium, and he does not consider the operative treatment at all. He reports two hundred and eighty-five cases treated by medical means. Of these two hundred and forty-nine had circumscribed perityphlitis, of which four died, while thirty-six cases with diffuse peritonitis all died. I have already pointed out the absurdity of statistics in the aggregate, and the necessity of classifying our cases in order to get reliable statistics of the different forms. Herzog, for instance, states that his mortality is fourteen per cent., while in reality he has one hundred per cent. mortality in the diffuse cases, and gives no information about the condition in all the other cases of "perityphlitis circumscripta." Rotter's<sup>1</sup> statistics of two hundred and thirteen cases with nineteen deaths show that appendicitis runs the same course in Germany as everywhere else. He states that all cases of diffuse peritonitis and localized abscesses in which pus was supposed to be present were operated on. Of diffuse cases, he operated on twenty-one, with a mortality of sixty-seven per cent.; of localized abscesses, thirty-six, with a mortality of fourteen per cent. His earliest operation was made on the sixth day. In reality he had fifty-seven serious cases, which is twenty-six per cent. (somewhat higher than usual), and nineteen of these died (thirty-four per cent.). Czerny's<sup>2</sup> conclusions are that the first acute attack belongs to internal medicine, unless perforation occurs, followed either by progressing diffuse peritonitis or by a localized abscess, and that cases of chronic recurring appendicitis belong exclusively to surgery. His statistics—twenty-eight acute cases with eight deaths (twenty-nine per cent.)—show the fallacy of his conclusions. It is with pleasure, therefore, that one turns to Sonnenburg's<sup>3</sup>

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<sup>1</sup> Über Perityphlitis, Berlin, 1896.

<sup>2</sup> Centralblatt der Chirurgie, Berlin, 1896, September 3, 1898.

<sup>3</sup> Deutsche Zeitschrift für Chirurgie, Band xxxviii. S. 285.

statistics and finds exactly the same results of surgical treatment and the same arguments for its use, perhaps even stronger expressed than by other authors, American not excepted.

Of seventy-seven operations, five were performed for simple appendicitis without perforation,—*i.e.* empyema,—and all recovered. Fifty-two operations were performed on account of perforation with local abscess, and all were successful. Of eight cases in which there were complications, such as multiple abscesses, progressive fibro-purulent peritonitis, etc., five recovered and three died; and, lastly, of thirteen operations for diffuse septic peritonitis all died. Sonnenburg's conclusions are, that the final outcome of appendicitis cannot be prophesied; that early surgical treatment not only is justified but alone is able to produce definite recovery and prevent relapses; that early operation gives the best result, fifty-seven such cases all recovering; that perforating appendicitis, which we are able to diagnose clinically, gives the indication to operation, and that the belief that perforative forms may heal spontaneously is fallacious and not proved in fact. We have no knowledge of the clinical features during life in such cases in which spontaneous recovery has been found at autopsies. For instance, all Finkelstein's cases, save one, were those of simple appendicitis. "Surgery alone is able by early evacuation of pus, which always is present in suppurating appendicitis, to prevent the further dangerous progress of the disease and bring on final recovery, which by expectant treatment is left to accident. The treatment of perityphlitis, therefore, belongs to surgery. The disease will then lose its dangerous character. It is not in our power to bring on spontaneous recovery, even if it may come by shrinking and obliteration of the appendix. We have let the opportunity of an operation slip, if recovery is imperfect, and we let the patients walk around with a chronic affection

which at any moment may change into an acute, fatal, universal peritonitis."

In his latest work <sup>1</sup> Sonnenburg publishes one hundred and thirty operated cases. Primary typhlitis was not found in a single case, and with the exception of one case the inflammation started in the appendix even in those cases in which all the symptoms of typhlitis stercoralis, particularly the early appearing tumor, were present. Seventeen cases were operated on for simple appendicitis, acute, chronic, or purulent-catarrhal, and all recovered. These are cases in which there is neither ulceration nor gangrene present, but catarrh or empyema with adhesive peritonitis, strictures, bends, etc. While he acknowledges that these cases may heal spontaneously, he states that they have an inclination to relapse, proving that the inflammatory process is progressive and may lead to perforation. Perforative appendicitis presupposes a previous appendicitis simplex. Of perforative appendicitis with local abscess, but without complications, he operated on seventy-four cases; all recovered. Less than half (thirty cases) were operated on during the first week, twenty-six in the second week, and eighteen still later. Only one case was operated on on the second day, three on the third, eleven on the fourth, nine on the fifth, three on the sixth, and three on the seventh day. Of perforative appendicitis with complications, such as multiple abscesses, progressive fibro-purulent peritonitis, pylephlebitis, pleurisy, empyema, thrombosis of iliac vein, abscess of liver, and sepsis, he had twenty-two cases, of which twelve died,—*i.e.*, fifty-five per cent. mortality. Lastly, fifteen cases which entered with perforation and septic peritonitis all died. Volkmann <sup>2</sup> says that typhlitis and perityphlitis are diseases that should be treated exclusively by

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<sup>1</sup> Pathologie und Therapie der Perityphlitis, Leipzig, 1895.

<sup>2</sup> Deutsche Med. Wochenschrift, 1889, No. 36, S. 753.

surgeons. An incision that does not meet pus does no harm, and recoveries from large abscesses and exudations under medical treatment lose their value on account of the frequency of relapses, which often terminate fatally. Kümmell<sup>1</sup> advises in chronic cases operation after the second attack; he had one hundred and four such operations, all successful. Max Schede<sup>2</sup> reported in 1892 eighteen operative cases; Krafft, Lange, Körte, Küster, Mikulicz, Finkelstein, Von Bergmann, Helferich, and many others have written on the subject and advanced our knowledge, particularly of the pathology.

France.—Of the more modern authors Paulier<sup>3</sup> is the first to call attention to early incision as advocated by Gouley and Parker, "which has perhaps been neglected in France." The treatment advocated is the antiphlogistic of the Broussais school, with purgatives, baths, leeches,—of which one hundred and fifty were applied on one patient and two hundred and fifty on another,—mercurial inunctions, and poultices. His mortality was really less than could be expected after this treatment. In his forty-nine cases there was a mortality of thirty-three per cent., but of eighteen cases with diffuse peritonitis fifteen died,—*i.e.*, eighty-three per cent. We hear little about operative treatment till Tuffier's<sup>4</sup> article appeared. It is a comparative investigation into the claims for surgical treatment, based, however, upon statistics of foreign authors, he himself having seen only five recent cases, none of which were operated, although he "many times has been at the point of interfering surgically."

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<sup>1</sup> Berliner Klinische Wochenschrift, April 11, 1898.

<sup>2</sup> Deutsche Med. Wochenschrift, April 23, 1892.

<sup>3</sup> Contribution à l'Étude de la Typhlite et de la Pérityphlite, Paris, 1875.

<sup>4</sup> De l'Intervention chirurgicale dans les Pérityphlites, Archives générales de Médecine, September, 1890.

Emile Maurin's<sup>1</sup> work appeared the same year (1890), and he also states that this affection has been somewhat neglected in France. He reports very interesting statistics of one hundred and thirty-six cases, in which the appendix was the point affected ninety-four times, the cæcum thirty-six times, and both six times. Of the ninety-four cases seventy-eight were males, sixteen females. Sixty-six had perforation, eleven simple gangrene, eight gangrene and perforation, five ulceration or cystic dilatation. Eighty developed peritonitis, of which forty-eight had diffuse peritonitis, nine localized abscesses, eleven localized abscesses perforating and producing peritonitis, four extraperitoneal abscesses, etc. The mortality was enormous, all dying but four,—*i.e.*, ninety-six per cent. mortality. Eighty-one died without operation, ten after operation,—four incisions and six laparotomies. Three recovered spontaneously after opium treatment, one after incision; forty-one per cent. died in the first six days. The treatment in the ninety fatal cases was still the antiphlogistic. Broussais's recommendation of leeches and bleedings, as used by Louyer-Willermay and Mélier, was, however, discarded. They used thirty leeches the first day, forty the second day, fifty the third day, not counting during the same time two or three bloodlettings of four hundred or five hundred grammes each. Repeated administrations of purgatives were, however, used. Maurin objects to purgatives and recommends opium, calling particular attention to Professor With's statistics as proof of its effect. "We try to fight the constipation which so often accompanies the disease, and forget that it, whether cause or effect of the disease, has a beneficial effect which we ought to favor. The great danger is to transform a partial, localized peritonitis into a general peritonitis." The four patients who recovered

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<sup>1</sup> Essai sur l'Appendiculite et la Péritonite appendiculaire, Paris, 1890.

were treated with opium. If, however, opium does not arrest the morbid process, and if this shows no inclination to recede, or, still more, if it continues to advance, recourse must be had to operation, in perityphlitic abscess by extra-peritoneal operation from the tenth to the twelfth day, in localized peritonitis by laparotomy, and in diffuse peritonitis by incision in the median line. "In these last cases we come often too late by delaying the operation twenty-four or forty-eight hours."

The most important work which I have come across is Charles Talamon's book.<sup>1</sup> Although over eight years old, it gives some pretty clear indications for operative treatment; but he considers those cases in which the inflammation is limited to the walls of the appendix, or in which the peritoneal affection is simply adhesive, as indisputably medical, although even then he considers the indications to have but a relative value. "The only absolute rule that can be given is the following: the moment the diagnosis of acute perforative appendicitis with generalized peritonitis is made, or of appendicitis with periappendicular suppuration, that moment it is time to abandon all medical treatment and summon the surgeon and let the responsibility of a laparotomy rest with him." "Theoretically,<sup>2</sup> surgical interference is indicated as soon as the diagnosis of perforative appendicitis is made. Practically, this interference should be immediate in cases of general peritonitis at the onset, from the eighth to the twelfth day in circumscribed abscesses, and in the quiescent state between two attacks in relapsing cases. In all other cases medical treatment ought alone to be employed, an operation made under pretext of preventing perforation being unjustifiable, considering the enormous proportion of cases which get well without the help of the bistoury. Physicians, how-

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<sup>1</sup> Appendicite et Pérityphlite, Paris, 1892.

<sup>2</sup> Loc. cit., p. 200.



ever, should know when to summon the surgeon; the surgeon when to operate and when not to operate." One cannot help pitying the French surgeon on whom "the responsibility of laparotomy must rest." Talamon, evidently, does not write from personal experience, has not made up his mind what to do, and furnishes no statistics of operated cases. Theoretically, operation is indicated when the diagnosis of perforative appendicitis is made, but practically we ought to procrastinate except in the necessarily fatal cases! The result can only be the same as under exclusive medical treatment. The only French surgeon I have come across who considers appendicitis a surgical lesion is Terrier.<sup>1</sup> He reports three cases, one acute, which died after operation on the sixth day, and two chronic, which recovered. He considers appendicitis a septic lesion in three-fourths of all cases, or that it may become so the very next day, and that we ought, therefore, to operate.

A great change has, however, taken place in France during the last two years, due more to Professor Dieulafoy than to anybody else. A prolonged discussion<sup>2</sup> took place in 1899 in Paris, both in the Surgical Society and among physicians in the Hospitals' Medical Society, and the result has been quite astonishing. While the physicians, led by Professor Dieulafoy, insisted that appendicitis ought to be treated by operation at the earliest possible moment, a number of well-known surgeons, led by Professor Tilleaux, considered a waiting policy and medical treatment quite sufficient, particularly in the first attack. *Dieulafoy's* con-

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<sup>1</sup> *Traitement de l'Appendicite*, Le Mercredi Médical, June 15, 1892, p. 231.

<sup>2</sup> *Le Progrès Médicale*, January to March, 1899, and *Bulletin de l'Académie de Médecine*, February 28, 1899.

clusions (and he is supported by many of the younger surgeons, who seem to have won the day) are: (1) that the medical treatment of appendicitis ought to be abandoned because it results in a mortality of thirty per cent., and (2) that the surgical treatment is the only rational treatment, but must be done early. The toxic infectious focus must be suppressed before irreparable infection has occurred. "Everybody temporizes in his own way," says Dieulafoy. "The patient temporizes in calling in his physician too late, the physician temporizes in calling in the surgeon too late, and the surgeon temporizes in the hope—often deceived—that the so-called medical treatment will allow him to operate in the interval, and we all know to where these paroxysmal temporizations lead." With the radical surgeons who advocate operation always and at the earliest possible moment he counts Reclus, Pinard, Chaput, Segond, Hartmann, Pozzi, Poirier, Routier, Kirmisson, Tuffier, Michaux, etc., and he considers himself in exceedingly good company with these men. *Reclus* agreed with Dieulafoy's conclusions. His rule is always to operate when the diagnosis is sure, and to operate as soon as possible, except in cases which are improving and can be watched and quickly operated on if it becomes necessary. *Dentu* advocated operation during the first day, before peritonitis has occurred and before adhesions have formed. *Tilleaux* objected to Dieulafoy's statement that "one ought never to die of appendicitis." Accidents will happen in spite of all precautions. We ought, however, to have recourse to surgical treatment unless the symptoms prove that resolution is probable and that medical treatment, therefore, may be of use. In such cases it is better to operate in the interval.

A long discussion also took place in the Surgical Society on April 26, 1899, at the close of which *Poirier* gave a résumé of the different opinions expressed. He had in the

beginning declared for immediate operation in all cases, and a large number of surgeons had freely taken his side. Others interfered only in the undoubtedly acute cases, and preferred to temporize in the other cases in order to operate in the interval. All agreed on the following points. (1) There is no medical treatment for appendicitis. (2) All cases should be operated on as soon as the diagnosis is made. (3) It is much safer to operate immediately, even where there are localized adhesions, as we expose the patient to less risk. (4) We ought to operate immediately in general peritonitis, although the chances of success are poor. (5) It is dangerous to postpone the operation. (6) The diagnosis is often difficult in the beginning. (7) Most surgeons favor a complete operation by removing the appendix. The remarks of some of the surgeons present are of interest. *Routier* would operate as soon as possible. One rarely regrets having operated too soon, but often regrets having temporized. No signs permit us to determine the cases in which medical treatment will be sufficient. He had operated on ninety-three cases in 1897 and 1898,—thirty-five in the interval, all of which recovered; thirty-three with or without abscess, with one death; and twenty-four with diffuse peritonitis, with ten recoveries and fourteen deaths. *Potherat* had never regretted having operated too soon; while *Richard*, on the other hand, thought that medical treatment was often sufficient to produce recovery, although there are cases in which operation is absolutely indicated. *Tuffier* considered immediate operation just as urgent as in strangulated hernia. In localized abscess, however, we may wait. *Brun* acknowledged that by immediate operation recovery may occur in otherwise fatal cases, but it is an advantage not to be in a hurry and to try medical treatment first. *Chaput* thought that all acute cases ought to be operated on, because peritonitis may develop with astonishing rapidity,

because it is impossible to make an exact diagnosis, because the prognosis cannot be foreseen with certainty, because delay aggravates the lesion, because an early operation is as innocent as an operation in the interval, and because operation can save those patients only whom delay will kill. He reported one hundred and thirty-one cases operated on in the interval without a death, one hundred and forty-six acute cases with six deaths, and one hundred and two cases with general peritonitis with eighty deaths. The gravity of this last form he considers the most important argument for early operation. *Quenu* preferred to temporize in the light cases, and to operate only when the diagnosis is sure. In hyperacute cases operation gives, in his opinion, the only chance; in acute and subacute cases we ought to be guided by the seriousness of the attack. The condition of the pulse, meteorism, changes in the features, and a certain bad odor in exhalation are the important signs of a grave crisis which demands immediate operation. *Berger* would reserve operation for cases with acute septic peritonitis, for cases with abscess, and for cases which do not improve on the fourth or fifth day. *Segond* was an absolute adherent of systematic operation, as the apparently benign cases, by waiting, sometimes rapidly develop into fatal ones. *Michaux* thought that we, by temporizing, exposed the patients to grave dangers. *Gérard-Marchant* had operated on fifty-six cases: fourteen in the interval, all of which recovered; thirty-seven with localized abscesses, of which two died; and five for peritonitis, with three deaths. *Hartmann* indorsed Dieulafoy: operation in the first twenty-four hours. To wait to see how the disease will develop is to wait to see the development of a general peritonitis. *Picque* had seen foudroyant cases die in a few hours. He believes in early intervention. Operation, to be sure, is not necessary in all cases, but the difficulty consists in knowing in which cases to operate im-

mediately, so much the more as the diagnosis sometimes can be made only by aid of the knife.

**Sweden.**—The foremost advocate of operative treatment in the Scandinavian countries is undoubtedly Professor Lennander in Upsala, whose work,<sup>1</sup> however, is more a description of, and a deduction from, sixty-eight operated cases. He advises rest in bed, absolute diet, ice locally, and opium in sufficient doses to relieve pain and keep the patient quiet. He believes that by this treatment not only serious complications can be prevented, but that perfect recovery may occur, even in chronic cases, “provided that there are no particular chronic changes in or around the appendix which make recovery impossible.” This advice, however, is purely theoretical, and he gives no statistics to prove his assertion. Practically, he operates upon his cases just as soon as he gets them,—upon some of them during the first two or three days after the commencement of the attack,—and the earlier the operation the better the result and the quicker the recovery. He operates during the attack:

*First.* When the attack is so severe that diffuse peritonitis is threatening or perhaps already present. This indication he considers absolute.

*Second.* In lighter forms, when improvement does not occur in spite of vigorous medical treatment, particularly when secondary ileus, dependent upon paralysis of the bowels or upon adhesions from fresh exudates, is present. He warns against delaying operations in these cases until fecal vomiting and a small, quick pulse are present.

*Third.* He operates in relapsing cases when the attacks occur frequently, even if not severe, when the last or the later attacks become more severe, and when after an attack a tumor or swelling, particularly if tender to pressure, con-

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<sup>1</sup> Ueber Appendicitis, Wien, 1895.

tinues in spite of medical treatment. This last indication he considers absolute, as "all the patients he has had under observation for a sufficient time have got relapses." This last statement seems to contradict his former one, that perfect recovery may occur even in chronic cases, and I believe that he will come to the same conclusion as myself: that perfect recovery rarely, if ever, occurs after a moderately severe attack, but that pathological changes are left behind in the appendix in the form of strictures, adhesions, cystic dilatations, bends, etc., which predispose to a new attack. His indications, it will be seen, differ not in the least from those of the most progressive American surgeons, and his results in the sixty-eight cases are exactly what we would expect to find,—a very small mortality in early laparotomies for suppurative cases (sixteen recoveries and one death from volvulus), the same in incision for localized abscesses (fourteen recoveries and one death from pyæmia operated on the forty-second day), sixty per cent. mortality in cases of diffuse peritonitis, no deaths in twenty-one cases of chronic appendicitis, and, lastly, in nine cases of gangrene, with progressive fibro-purulent peritonitis but without perforation, eight recoveries and one death, after operation *in extremis*. Two interesting papers from Sweden have since appeared, one by Floderus,<sup>1</sup> from Lennander's clinic, and another by Barthold Carlson.<sup>2</sup> They both deal largely with the treatment of diffuse peritonitis, and will be referred to in the chapter on surgical treatment.

**Denmark.**—Since Professor With's classical treatise in 1879, the first work that has appeared in Denmark is Dr. Floystrup's<sup>3</sup> book in 1888, and it is of historical interest as

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<sup>1</sup> Archiv für Klinische Chirurgie, 1897, S. 55.

<sup>2</sup> Den diffusa variga peritonitens behandling, Hygieia, November, 1898

<sup>3</sup> Perityphlitis og dens Behandling, Kjöbenhavn, 1888.



showing the opinions which were held twelve years ago. He reported in his book one hundred and fifty-six cases, of which twenty-four died,—*i.e.*, fifteen and four-tenths per cent. mortality. They were all treated exclusively with opium. The fatal result was due in thirteen cases to primary diffuse peritonitis, in eight cases to circumscribed abscesses perforating later into the peritoneal cavity, and in three cases to retroperitoneal abscesses. Retroperitoneal abscesses only were considered proper for operation, and of the one hundred and fifty-six cases only four, all with retroperitoneal abscesses, were operated upon.<sup>1</sup> The arguments against operative treatment in cases with diffuse peritonitis were, that in the majority of cases it is impossible to diagnose the point of perforation or the primary affection, and that we therefore are forced to be satisfied with the constipating method, “which is not quite hopeless.” In circumscribed abscesses it was supposed to be quite impossible to find small abscesses, and even the larger ones were not easily diagnosed. We would, besides, by laparotomy run the risk of loosening the fresh adhesions and making the peritonitis diffuse. There would, therefore, only rarely be indication for operative treatment. The extraperitoneal abscesses, however, were less dangerous to operate and the diagnosis easier, except when they started in the folds of the mesentery, in which case they could neither be diagnosed nor treated surgically. There would, therefore, relatively rarely be occasion to operate for perityphlitis, partly on account of the difficulty of the diagnosis, partly on account of the dangers of the operation. The late lamented Dr. Iversen read a paper in the Copenhagen Medical Society on appendicitis on January 20, 1891, in which he particularly called attention to the septic lymphangitis. He advised (1)

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<sup>1</sup> Loc. cit., pp. 49–51.

extirpation in the quiescent period, of which he reported a few successful cases, (2) incision of abscesses without removal of the appendix, and (3) not to operate cases with acute septic peritonitis from perforation. More recently another book has appeared, by Dr. Monrad,<sup>1</sup> in which the author, although giving a clear description of the acknowledged etiology and pathology of appendicitis, still maintains that the opium treatment is the all-important one, and that in spite of his statistics: thirty-three per cent. mortality in all cases, eighty-three per cent. mortality in children under six years of age, and twenty per cent. mortality in those from six to sixteen years. Every case with peritonitis—eighteen in all—died, whether treated medically or surgically. The conclusion is that the opium treatment had not the slightest influence in a single case, and in the five cases in which operation was performed it was done too late,—on the fifth day in the earliest case. The author comes to the conclusion in regard to the diffuse cases that “the opium treatment so far is powerless to influence the cause of the diffuse peritonitis, and that this disease, for the time being, must be considered hopeless and to belong to surgery.” The localized cases—forty-three in all—had generally very slight attacks. Two died, operated on the twenty-first and twenty-second days, and the rest recovered,—twenty-three after late incisions and twenty by the opium treatment, or, perhaps more correctly, in spite of the opium treatment, by the healing power of nature. The first operative statistics from Denmark are published by Dr. Tscherning,<sup>2</sup> who reports nineteen cases operated in the interval, and a single case operated successfully for diffuse peritonitis by Dr. Rovsing.<sup>3</sup> This is all of recent Danish contribution to the subject which

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<sup>1</sup> Appendicitis hos Börn, Kjöbenhavn, 1897.

<sup>2</sup> Hospitalstidenden, May 3, 1899.

<sup>3</sup> Ibid.

has come to my notice, with the exception of Dr. L. Kraft's article on "Appendix Vermicularis i Brok," in *Nordisk Medicinsk Archiv*, 1894, Heft 4.

**United States of North America.**—In America we find the opinion prevalent that the appendix ought to be removed as soon as the diagnosis is made. It would be impossible to mention and review the enormous literature which has grown up during the last four or five years, and I shall therefore mention only the more important contributions. The arguments for early operation in general are that we are unable in a given case to tell what the result will be; that an early laparotomy under proper precautions is almost devoid of danger; that perforation is often present from the start, and that relapses are avoided. McBurney,<sup>1</sup> who more or less is the father of early laparotomy, considers it far more important for us to know when that pathological process begins which directly causes the deaths on the third, fourth, and fifth days! He thinks it safe to say that in a very large majority of the cases dying within the first five days the fatal sepsis, hopeless for medicine and nearly hopeless for surgery, begins before the end of the third day. It is not best to wait for strong evidence of perforation, abscess, or general peritonitis. When we discover spreading peritonitis, peritonitis has already spread. No one can name the signs of impending perforation, and we should endeavor to anticipate the bad symptoms. The question of operation should therefore be deliberately and carefully discussed, and the operation performed in all the cases which after the end of thirty-six hours show well-marked signs of increasing disease.

Professor W. W. Keen,<sup>2</sup> of Jefferson Medical College, lays

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<sup>1</sup> *Annals of Surgery*, April, 1891, p. 243.

<sup>2</sup> *Ibid.*, pp. 259 and 262.

it down as a rule that even in mild cases that are apparently convalescing, if the indications point even slightly towards pus, an early operation should be done. If pus is present the propriety will be denied by no one, and if absent a simple exploratory operation with all the precautions of modern antiseptic surgery is so far from being dangerous that no patient should be allowed to run the risk of a probable or possible rupture and general peritonitis, as an exploratory operation carries with it less danger than the disease. He advises, as a rule, operation on the second day, or certainly on the third, (1) if there is abdominal pain, most marked in the right iliac region, with tenderness at McBurney's point, attended by nausea and vomiting; (2) if there is rigidity of the right abdominal wall; (3) if the temperature is from 100° to 102° F.; (4) if tumefaction with increased resistance can be felt; and (5) if there be oedema of the abdominal wall. "The first indication is to call a surgeon."

G. R. Fowler<sup>1</sup> states that the prognosis, in his judgment, is always uncertain in cases in which no operative interference is instituted, and favorable only in cases which are neither progressive nor stationary, but, on the contrary, retrogressive within the first twenty-four hours of attack. The great majority of cases should be treated surgically. "As soon as the diagnosis of progressive appendicitis is assured, the abdominal cavity should be opened and the appendix removed. If opium has been injudiciously administered, and the progressive character of the case in hand is doubtful, it is better to err on the side of safety, and remove the appendix at once. To operate too early may be to operate unnecessarily, but this is always preferable to operating too late and hence unsuccessfully."

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<sup>1</sup> Observations on Appendicitis, *Annals of Surgery*, March, 1894.

Professor J. W. White,<sup>1</sup> of the University of Pennsylvania, believes few, if any, surgeons would dissent from the following rules for indication to operation, which he considers indisputable :

Immediate operation when the onset is marked by suddenness and severity.

Whenever, even in a mild attack, the symptoms at the end of forty-eight hours are unrelieved or growing worse.

Whenever, in cases seen later, a firm, slowly forming, well-defined mass is felt in the right iliac region.

Whenever sudden increase of pain and rapid diffusion of tenderness occur.

Whenever there is reason for considering the appendicitis tubercular in character.

Whenever attacks of any type have been numerous, *or* are increasing in number and gravity, *or* have unfitted the patient for work and activity, *or* have caused local, permanent, and consistent symptoms, *or* have at any time put the patient's life in great danger.

If the symptoms get worse, instead of better, at the end of forty-eight hours or earlier, operate at once, as these symptoms indicate perforation, and as there is absolutely no way of recognizing which of the following three events will occur : resolution with recovery, localized abscess with ninety or ninety-five per cent. of chances in the patient's favor, or general peritonitis with almost sure death. J. B. Murphy,<sup>2</sup> of Chicago, says that the operation should be performed as soon as a diagnosis is made, as we cannot differentiate in the early stages which cases are going to be favorable, and as

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<sup>1</sup> University Medical Magazine, March, 1896, and Address on Appendicitis, Therapeutic Gazette, June 15, 1894 ; see also editorial article in Annals of Surgery, June, 1896.

<sup>2</sup> Medical News, January 5, 1895.

the earlier the operation the less the danger and the easier the removal.

J. A. Wyeth<sup>1</sup> expresses as his opinion that, if all of a thousand suspected cases were operated upon, the mortality would probably be fifty per cent. less than in another thousand cases treated conservatively without operation, and that the rate of perfect recovery under so-called conservative treatment would be about fifteen in every hundred, excluding those which suffer relapses after an acute attack. In the light of further experience he declares that, if the error of operating on every suspected case of appendicitis were made, and the operation performed by a surgeon who knows what practical asepsis and careful technique are, the mortality would not be five per cent. He looks upon appendicitis as a strictly surgical lesion, and believes that cases which are cured without operation are either mild in type, with a gradual and limited infection and a copious plastic exudate, which subsequently may be absorbed after restoration of the canal, or else recover as the result of a blind chance in the formation of adhesions strong enough to protect the peritoneal cavity till the abscess breaks through somewhere else. These last cases are accompanied by great danger to life and future usefulness, all of which may be prevented by early operation. Deaver<sup>2</sup> believes that there is but one course to pursue in order to obtain the best possible result, —*i.e.*, to remove the appendix as soon as the diagnosis has been made. Appendicitis is a surgical affection and should be treated as such. We cannot foretell, with even the slightest amount of assurance, the issue of any attack of appendicitis. The main point to consider, then, is, Shall we risk the patient's life or shall we accept the only alternative

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<sup>1</sup> Medical Record, November 26, 1892, and May 9, 1896.

<sup>2</sup> A Treatise on Appendicitis, Philadelphia, 1896, pp. 116 and 122.



and remove the organ in its incipient stage? Such an operation is a conservative and not a radical one. Willy Meyer<sup>1</sup> says, "In cases of doubt the operation is generally safer than waiting, provided the patient is still in the early days of the attack." Richardson's<sup>2</sup> answer is, that, "as a rule, the appendix should be removed if the diagnosis is made in the first hours of the attack. After the earlier hours operation is advisable (1) if the symptoms are severe, and especially if they are increasing in severity; (2) if the symptoms, after marked improvement, recur; and (3) if the symptoms, though moderate, do not improve. The wisdom of the operation is questionable (1) in severe cases in which an extensive peritonitis is successfully localized and the patient improving, and (2) in cases which are in a critical stage and which cannot successfully undergo the slightest shock."

I might continue to make similar extracts from the writings of scores of prominent American surgeons, with the same result, that the appendix should be removed early, unless the case shows great improvement and abatement of the serious symptoms inside of twenty-four or forty-eight hours.

*Where surgeons differ* is in regard to the proper treatment of acute cases seen from the third to the sixth day. Shall these cases, which Richardson<sup>3</sup> described as "too late for an early operation and too early for a late operation," be operated early, with the risk of infecting the general peritoneal cavity, or operations be delayed till the circumscribing wall is stronger, with the risk of spontaneous perforation of the abscess into the peritoneal cavity, and, finally, shall we remove the appendix or simply open and drain the abscess?

The question is not whether it is preferable to remove the

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<sup>1</sup> Medical Record, February 29, 1896.

<sup>2</sup> American Journal of the Medical Sciences, December, 1899.

<sup>3</sup> Ibid., January, 1894.

appendix in all cases or treat the patients medically, but whether removal in all cases is preferable or not to the more conservative and less dangerous method of simply incising and draining the abscess with perhaps subsequent removal of the appendix by a secondary operation if necessary. White<sup>1</sup> does not consider this question settled, although he believes that operation is certainly indicated whenever a firm, slowly forming, well-defined mass is felt in the iliac region or when a sudden increase of pain and tenderness points to perforation. He considers it, however, poor surgery in every case and at every period to insist upon finding and removing the appendix in the face of obstacles. Richardson<sup>2</sup> thinks incision and drainage of abscesses sufficient, and considers it extremely dangerous to break down the barriers between an appendicular abscess and the rest of the peritoneal cavity in order to remove the appendix. He advises against its removal (1) in localized abscesses with firm walls (2) and when the patient's strength does not permit prolonged search. It should be removed whenever the peritoneal cavity is opened, unless the patient's condition forbids it, and in all inflammatory cases as soon as the inflammatory process has had time completely to subside. In cases simply drained the scar tissue should be excised, the appendix removed, and the wound securely sutured. McBurney<sup>3</sup> believes that a reasonable effort should be made in every case to find and remove the appendix. He looks upon every case of suppurative disease of the appendix as being ripe for operation as soon as the diagnosis is made. He would never wait two or three

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<sup>1</sup> Therapeutic Gazette, June 15, 1894, pp. 34, 54.

<sup>2</sup> American Journal of the Medical Sciences, January, 1894, and December, 1899.

<sup>3</sup> Annals of Surgery, June, 1896, p. 752, and New York Polyclinic, January 15, 1897.

days in order that the abscess may come nearer to the anterior abdominal wall, because serious accidents might happen while one is waiting. Every case should be dealt with according to conditions present. If the abscess be three days old it should be handled in one way ; if ten days old it must be managed in another way. In one case the appendix should be left alone, because it would be dangerous to take it out ; in another it should be taken out, because it can be done without additional risk to the patient. In some cases it cannot be removed, because it cannot be found. It may be buried in the wall of an abscess, and when in this situation it is usually better to abandon the search, for fear of making an opening into the intestines. Furthermore, such a search may occupy a long time and lead to the necessity of greatly enlarging the wound. If free drainage is established the remnant of the appendix will not be apt to cause trouble, and should it do so, it can safely be operated upon. Almost all the serious obstacles to complete and safe operation depend upon delay in operating. W. T. Bull,<sup>1</sup> of the New York Hospital, advises the removal of the appendix if readily found and easily separated from the adhesions. He does not attempt to remove it in cases operated upon later than the seventh or tenth day, the more so as only a small proportion of cases suffer relapses or fistulas, both of which may be operated on secondarily. N. Senn,<sup>2</sup> of Chicago, takes the same view and simply incises and drains in cases of large abscesses. Fenger,<sup>3</sup> of Chicago, thinks that no attention should be paid to the appendix in cases of abscess, except, of course, in early operations and in operations for acute suppurative peritonitis. Murphy<sup>4</sup>

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<sup>1</sup> *Annals of Surgery*, June, 1896, p. 764.

<sup>2</sup> *Journal of the American Medical Association*, March 9, 1896, p. 912.

<sup>3</sup> *American Journal of Obstetrics*, 1893, vol. xxviii., No. 2.

<sup>4</sup> *Medical News*, January, 1895.

believes it advisable to open and drain and make no effort to remove the appendix. Deaver,<sup>1</sup> on the other hand, considers it incomplete surgery to leave the appendix behind, and believes it possible and always advisable to remove it, as in no other way will recovery be assured. So does Morton.<sup>2</sup> "Those who advocate leaving the appendix belong to the class of surgeons whose experience is limited in this kind of work." While the majority of American surgeons are conservative on this point, we find the opposite view expressed by several distinguished surgeons abroad.

Lennander<sup>3</sup> considers it dangerous to leave the appendix, even if we run the risk of opening the peritoneal cavity by searching for it. He had three cases of relapse where he did not remove it. Sonnenburg<sup>4</sup> considers it his duty to remove it in every case possible, in order not to overlook coprolites and leave necrotic tissue behind, which will occasion relapse. Particularly is this necessary in all pus cases, in order to reach all the collections of pus around and behind the appendix, and in order to cure the patient definitely. His only exceptions are cases with great technical difficulties, as, for instance, perfect and intimate adhesion to the cæcum, in which the removal may lead to injury of the serosa of the cæcum, followed by gangrene and fistulas. Mikulicz, on the other hand, is satisfied with incisions and drainage, as is Kümmell<sup>5</sup> and Czerny.<sup>6</sup> Monod<sup>7</sup> states that we, without doubt, may see relapses in some cases in which the appendix

<sup>1</sup> Loc. cit., p. 130, and *Annals of Surgery*, January, 1898.

<sup>2</sup> *Journal of the American Medical Association*, 1888, p. 734.

<sup>3</sup> Loc. cit., p. 33.

<sup>4</sup> Loc. cit., p. 173, and *Mittheilungen a. d. Grenzgebieten der Medicin und Chirurgie*, 1898, Band iii. S. 9.

<sup>5</sup> *Berliner Klinische Wochenschrift*, April 11, 1898.

<sup>6</sup> *Beiträge zur Klinischen Chirurgie*, Tübingen, 1898, Band xxi.

<sup>7</sup> Monod et Vanverts, *Appendicite*, Paris, 1897.

was not removed, but these cases are exceptional. Ordinarily, after an incision, the appendix atrophies or is eliminated by gangrene. It has been my custom in treating large abscesses after delayed operations simply to incise the abscess and leave the appendix alone. We may with the greatest ease, and in spite of all possible care, rupture the limiting adhesions and open the peritoneal cavity during such an attempt, and it is very difficult then to prevent pus from entering the abdominal cavity. I have seen death result from such an attempt in the practice of other surgeons, and I advise in these cases only to make incision and drain. It is the duty of the surgeon to save life and not to put it in jeopardy by attempting to make a brilliant and perfect operation. A few surgeons with great technical skill and large experience may, perhaps, remove it safely in every case, but I consider it much safer for the great majority of surgeons simply to incise and drain. Particularly is this the case if the appendix is found on the inner side of the cæcum or else extending inward, while we may safely remove it if we find it on the outer side of or below the cæcum. The danger of relapse and of fecal fistula when it is left behind is not great. Fowler<sup>1</sup> had recurrence twice in seventeen cases; Barton,<sup>2</sup> of Philadelphia, twice in twenty cases; Richardson,<sup>3</sup> of Boston, twice in forty cases. I have had two recurrences in twenty-seven cases, and removed the appendices during the attacks. Two suffered, however, from fecal fistula, which healed spontaneously in a few weeks. Wood<sup>4</sup> states, after collective investigations, that recurrence occurs in these cases in less than five per cent., and then mostly within a few months. One point seems to be established: that first attacks terminate fatally more frequently and more quickly in children than in

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<sup>1</sup> Loc. cit.<sup>2</sup> *Annals of Surgery*, June, 1896, p. 755.<sup>3</sup> Loc. cit.<sup>4</sup> *Medical Record*, August 22, 1896, p. 257.

adults, and that, therefore, operative proceedings are still more necessary in childhood and should not be delayed.

In chronic recurring cases we hear less in America about the question whether it is preferable to remove the appendix during the quiescent period, after the first attack, after the second attack, or during an attack, as it is here well recognized that there is no danger, or, at least, very little danger, connected with such an operation, and as the advantage to the patient of its removal would by far counterbalance the relapses with their possible dangers and the great waste of time. No American surgeon, at any rate, would delay operation on a patient who was suffering from an acute attack, in order to remove the appendix after he had recovered.

McBurney<sup>1</sup> thinks that where a patient has had two attacks operation ought to be performed before a third attack occurs, the more so as many patients who have passed successfully through five or six comparatively mild seizures have on the next occasion become fatally ill, and because, as a rule, the more numerous the attacks the more difficult the operation on account of the dense and numerous adhesions.

Bull<sup>2</sup> says that we need more carefully recorded cases, not only of patients who come to operation, but of those who have successive attacks relieved by medical measures. He operates when the attacks become frequent and severe. He found that the adhesions correspond to the severity of an attack. He reports statistics of four hundred and forty-two operations with eight deaths,—*i.e.*, one and four-fifths per cent. mortality. Fitz<sup>3</sup> believes that recurrent attacks should be treated as first attacks. Removal between attacks should

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<sup>1</sup> Loc. cit.

<sup>2</sup> Medical Record, 1894.

<sup>3</sup> Boston Medical and Surgical Journal, June 19, 1890.



be advocated, if recurrence is so frequent as to debar the patient from enjoyment of life.

Deaver<sup>1</sup> has no doubt that, without exception, every appendix that has been the seat of an inflammatory process is a source of danger to the life of the patient and should, therefore, be removed. White<sup>2</sup> states that the interval in chronic relapsing cases is not one of perfect health; we find digestive disorders with pain, aggravated by exercise, and anæmia. Operation gives a very small mortality, if any. Perhaps the immunity of the peritoneum acquired after repeated attacks may, as Treves states, have something to do with the low mortality.

#### MEDICAL TREATMENT.

Under the antiphlogistic treatment prevailing more or less up to the present time, and within a few years prevalent in France, the mortality was simply enormous. The introduction of the opium treatment by Voltz,<sup>3</sup> later emphasized by Bamberger,<sup>4</sup> Leudet,<sup>5</sup> With,<sup>6</sup> and others, has apparently reduced the mortality in the less serious cases and probably done much to prevent dangerous complications. Whether it has any effect in the serious cases is, however, questionable.

It is, of course, evident that the large majority of cases will be seen first by the family physicians, and that they will prescribe rest in bed, fluid diet, and local treatment, such as poultices or ice, leeches, etc.

We meet the most contradictory opinions when the question is about the use of opium or cathartics. *Opium* has, of

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<sup>1</sup> Loc. cit., p. 125.

<sup>2</sup> Loc. cit.

<sup>3</sup> Archiv für die gesammte Medicin, 1843, Band iv. S. 305.

<sup>4</sup> Ueber die Perforation des wurmförmigen Anhangs, Verhandlungen des physicalisch Med. Gesellschaft in Würzburg, 1859, Band ix. S. 123.

<sup>5</sup> Archives générales de Médecine, 1859, vol. ii. p. 315.

<sup>6</sup> Loc. cit.

course, no influence upon the disease itself and its cause, the microbes, but only upon one single symptom, the pain, and upon the peristaltic motions. The microbes will grow and develop whether we give opium or not, and we gain principally a certain amount of comfort for the patients, which, however, may completely mask the symptoms and lead us to defer the operation. We would scarcely, with our present knowledge in pathology, call opium an antiphlogistic remedy. I acknowledge that it may be of great importance to prevent or perfectly suppress the peristaltic motions, particularly in threatening gangrene and perforation. We thereby give the peritoneum a chance to take measures and intrench itself against the threatening attack by fibrinous adhesions in the neighborhood. The adhesions are, however, often so weak and imperfect that they do not prevent perforation into the peritoneal cavity. We are lulled to sleep trusting in the action of opium, and awake first when the fortress is taken. Meteorism, which occurs during the use of opium, even if not severe, is partly injurious. Meteorism will occur in every serious case, however, and the use of opium may increase it. Physicians of great prominence and experience, however, and whose opinions are entitled to respectful attention, are in favor of the use of opium.

Pepper<sup>1</sup> considers opium in full doses the great stand-by, and condemns purgatives, except in typhlitis stercoralis and general peritonitis. He believes that the mortality has been greatly lessened by its use. Osler<sup>2</sup> advises rest and opium, and warns against the indiscriminate use of salines, which means more or less disturbance of the local conditions and

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<sup>1</sup> American Text-Book of Principles and Practice of Medicine, Philadelphia, 1894, vol. ii. p. 823.

<sup>2</sup> Practice of Medicine, 1894, p. 412.

a definite increase in the risk of general peritonitis. He believes, with Tait and Pepper, that salines sometimes do good in general peritonitis. In no country has the use of opium in our days been carried to such extremes as in Denmark, and nowhere can we better study the result, as we find it in universal use in the large hospitals. Professor With<sup>1</sup> noticed the unfavorable influence of cathartics on peritonitis after perforation, particularly that pain, vomiting, tenderness, and meteorism increased after defecation, and he used them first when the local symptoms had completely disappeared. He tried to prevent even the spontaneous evacuation of the bowels by increased use of opium, as he in some cases had observed light relapses after its occurrence, and he kept the patients constipated for twenty-four days, if necessary. The amount of opium used in localized and less severe forms was five or eight drops of the tincture three times a day; in more severe forms ten drops three times a day, and an evening dose of fifteen drops, or a morphine injection of one-sixth of a grain. In diffuse peritonitis ten or twenty drops were used every half-hour or every hour, and repeated injections of morphine. The opium treatment was used in the lightest cases for ten days, in the more severe cases fourteen days or longer, up to twenty-four days; the amount has been increased to ten or fifteen drops in the lightest cases, fifteen or twenty drops, or a half-grain of morphine subcutaneously, several times a day in cases of localized abscesses, and twenty or thirty drops, with injections of one-half or three-fourths of a grain of morphine three times a day in diffuse forms. Spontaneous movements of the bowels occur usually when we cease its use, or after an enema. The result of this treatment was a mortality of sixteen per cent. in all cases, but seven of his cases un-

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<sup>1</sup> Loc. cit., pp. 80 and 81.

doubtedly had primary peritonitis from perforation, and five cases peritonitis from secondary perforation of a local abscess, and they all died in spite of the opium treatment: one on the fifth, one on the seventh, one on the eighth, two on the ninth, one on the tenth, three on the fourteenth, one on the fifteenth, one on the twentieth, and one on the forty-sixth day. Of the serious cases, therefore, the mortality was seventy per cent. Seventeen cases, all of more or less light forms with local circumscribed affections, recovered by the opium treatment after, on an average, thirty-four days' treatment in the hospital. The shortest time was twelve days, the longest sixty-four days.

In Dr. Floystrup's<sup>1</sup> statistics of one hundred and fifty-six cases there was a mortality of twenty-four,—*i.e.*, fifteen and four-tenths per cent.; but he reports only the histories of the fatal cases, and there is absolutely no information about the recovered cases, except a report about how many in three groups—diffuse peritonitis, localized abscesses, and retrocæcal abscesses—had had physic before entering the hospital. If we consider the cases in these groups, thirty-four had diffuse peritonitis, of which thirteen died,—*i.e.*, forty per cent.; of fifty-seven of the second group eight died,—*i.e.*, fourteen per cent.; while of the last group, sixty-five cases, three died,—*i.e.*, four per cent. It is not probable, however, that sixty-five of one hundred and fifty-six cases should have suffered from retrocæcal abscesses, a comparatively rare form, and we must exclude this group as not giving clear and precise information. The two other groups would give a mortality of twenty-three per cent., but no information is furnished except about the fatal cases.<sup>2</sup> Monrad's<sup>3</sup>

<sup>1</sup> Perityphlitis og dens Behandling, Kjöbenhavn, 1888.

<sup>2</sup> Loc. cit., p. 29.

<sup>3</sup> Appendicitis hos Börn, Kjöbenhavn, 1897.

statistics show the same result. Eleven of his third group, which were all treated medically with strict opium treatment, had diffuse peritonitis, and they all died: one on the sixth day, one on the seventh, one on the eighth, one on the tenth, two on the sixteenth, two on the seventeenth, one on the thirty-first, and one on the forty-eighth day. Twenty had local circumscribed inflammations and recovered, at least for the time being. We may, however, conclude that under strict opium treatment in all cases the mortality will be about sixteen per cent., apparently much less than under the antiphlogistic treatment, as Maurin used it, with a mortality of ninety-six per cent. I say apparently, because we must know what kind of cases Maurin treated. If his cases were all forms with diffuse peritonitis, then his results are *identical* with With's, Floystrup's, and Monrad's, who use opium exclusively, in spite of his antiphlogistic treatment. Perforation and diffuse peritonitis, in a few cases secondary to a local abscess, were found in all of Maurin's ninety fatal cases. Four recovered: one by incision, one by perforation into the rectum, and two by opium treatment on the thirteenth and twenty-fifth days. Maurin supposes that perforation had been present in the two opium cases, but the histories do not give any information. Two patients were under six years of age, and twenty-four from six to sixteen. Five died on the third day, four on the fourth, thirteen on the fifth, six on the sixth, six on the seventh, six on the eighth, and so upward to the sixtieth day. A comparison of these statistics seems to justify the conclusion that the opium treatment is an illusion from beginning to end, and of about the same worth as the antiphlogistic treatment. I have previously called attention to the fallacy of computing the mortality from cases in the aggregate. In one hundred cases we meet about twenty serious ones, and as the mortality under any kind of medical treatment is about twenty per cent., more or

less, we may with fairness maintain that almost all the serious cases die under medical treatment regardless of the method adopted, while the light cases recover, at least for the time being, but independent of any medical treatment employed. Compare this result with that of operative treatment in all cases, as mentioned on previous pages. Other physicians, and surgeons particularly, have quite different ideas about the use of opium in appendicitis. Hawkins<sup>1</sup> considers it best to err on the safe side of constipation. No purgatives should be given till the patient is well enough to leave his bed. Opium is essential in order to allay pain and prevent peristaltic motions, but he thinks it important to discontinue its use when these two objects have been gained, and it is seldom required beyond the first two or three days. He advises its use sparingly in all conditions in which an operation may become necessary. "A patient suffering from peritonitis and under the influence of opium is seen as through a glass, darkly. If he is thoroughly under its influence, the effect is so great that it may be difficult to take a serious view of the case, and surgical relief may be postponed in consequence until the final collapse has set in."

Sahli<sup>2</sup> believes that the treatment with large doses of opium has done much harm. He considers it more advantageous to the patients to use small doses, sufficient to control the colicky pains and make the patients comfortable.

Kelynack<sup>3</sup> considers opium useful when administered judiciously, but condemns strongly large dosing with opium, as it masks the symptoms. Deaver<sup>4</sup> considers its use dangerous, because it hides the symptoms and causes constipation, meteorism, and nausea. One of the most important symptoms is pain, which generally is in proportion to the degree

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<sup>1</sup> Loc. cit., p. 118.

<sup>2</sup> Loc. cit., p. 211.

<sup>3</sup> Loc. cit., p. 156.

<sup>4</sup> Loc. cit., p. 119.



of inflammation, and opium robs us of this valuable diagnostic aid. McBurney<sup>1</sup> advises morphine after positive diagnosis has been made, but before that none, as it masks the symptoms. He also advises against cathartics in the beginning, as they increase vomiting and pain. Fowler<sup>2</sup> says that, "above all things, the use of opium must be avoided as much as possible. Its use masks the progressive character of some of the most important symptoms."

Thornley Stokes<sup>3</sup> thinks that opium should be used most cautiously, and that pain is the only indication for its use. By concealing the pain "it may keep the surgeon in a fool's paradise." Dieulafoy<sup>4</sup> says pointedly, "What good will it do, I ask, whether we administer or not a few grammes of magnesia or a few grains of opium, or a few centigrammes of belladonna, when we have an hermetically closed appendicular canal, a little cavity isolated from the intestinal canal? Of what use is it in such a condition to administer a purgative, opium, or belladonna?" Treves says that as soon as the pain has ceased the opium is to be stopped.<sup>5</sup> We find, on the other hand, just as strong adherents of the moderate use of cathartics.

Professor J. W. White<sup>6</sup> advises in all ordinary mild cases the use of salines until free purgation is assured, and then to continue the action more gently by divided doses of calomel. He uses opium only in cases of severe, spontaneous, colicky pains, and then combined with calomel. Thornley

<sup>1</sup> Dennis's System of Surgery, New York, 1896, vol. iv. p. 416, and New York Polyclinic, January 15, 1897.

<sup>2</sup> Annals of Surgery, March, 1894, p. 334.

<sup>3</sup> A Clinical Lecture on Inflammation of the Cæcum and its Appendix, British Medical Journal, June 1, 1895, p. 1192.

<sup>4</sup> Bulletin de l'Académie de Médecine, February 28, 1899.

<sup>5</sup> Clifford Allbutt's System of Medicine, 1897, vol. iii. p. 930.

<sup>6</sup> Therapeutic Gazette, June 15, 1894, p. 22.

Stokes<sup>1</sup> thinks that purgatives are not to be dreaded except in cases of great acuteness and intensity. He gives two drachms of sodium sulphate every hour till action of the bowels, but first tries an enema, which he considers the safest and best agent, as, in his opinion, the disease in the majority of cases depends upon an overloaded colon. Deaver<sup>2</sup> states that medical treatment consists mainly in the administration of laxatives, and that these should be used in the beginning of every attack of appendicitis.

Talamon<sup>3</sup> thinks that there is a middle way between using cathartics systematically in all cases and discarding them altogether. It is, in his opinion, well not to use them in the onset, because the intestines, which are violently excited and under powerful contractions, might force the coprolite still farther in and effect its permanent lodgement. He believes, wrongly as Stokes, that these form in the cæcum. After depletion with leeches, he uses a purgative in order to empty the large intestines and produce peristalsis, which may force the coprolite into the cæcum again, from whence it came. Fowler<sup>4</sup> states that, beyond the careful use of salines in the very commencement of the disease, and then only if the symptoms denote a mild type of the affection, the less medical treatment the better. McBurney<sup>5</sup> (and most surgeons with him) avoids carefully cathartics and enemas, that all peristaltic action may be discouraged, as they increase vomiting and pain. Treves<sup>6</sup> says that the most difficult problem in the early treatment of an attack is that of the use of an aperient. If the onset be mild, a purgative should be given at once. Supposing, on the other hand, that the onset of the

<sup>1</sup> Loc. cit.<sup>2</sup> Loc. cit., p. 116.<sup>3</sup> Loc. cit., p. 185.<sup>4</sup> *Annals of Surgery*, March, 1894, p. 334.<sup>5</sup> *Ibid.*, April, 1891, p. 239.<sup>6</sup> Clifford Allbutt's *System of Medicine*, 1897, vol. iii. p. 930.

attack be very severe and acute, the administration of an aperient at once cannot be entertained. It is well in such cases to wait a few days until the acute manifestations have subsided, and then, on the fourth to the sixth day,—if the case be progressing well,—to make an attempt to relieve the bowel by an aperient, followed and assisted by an enema.

The main objection to opium seems, therefore, to be its power to mask the symptoms; the main objections to cathartics are the increased peristaltic motion, the pain, and the vomiting. In my own practice I use opium in sufficient doses to make the patient comfortable and prevent peristaltic motions, as soon as the diagnosis is made and until the operation can be performed. I consider the use of cathartics in acute diseases decidedly dangerous. I have never seen them do good, and I have often seen them do distinct harm. I believe that we ought to be careful in prescribing them, because we cannot in a given early case know with absolute surety the condition of the appendix. I believe that cathartics would be harmless or even beneficial if we could know positively that there was no perforation present and that none would occur. Their use would probably more or less prevent limiting adhesions, but the derivation to the mucous membrane of the bowels and the absorption of exudates would counterbalance the injury which might result from that. It is quite another question whether we ought to use them after operation has been performed. I believe that the earlier they are given after the operation, particularly if commencing diffuse peritonitis is present, the better for the patient, provided they are not vomited up again. We may often prevent this by irrigating the stomach first. I use them in cases of threatening peritonitis, or when peritonitis is present, as soon as the patient is able to swallow after the operation, and I prefer to give one-half grain or one grain of calomel with two and a half grains of soda every hour till

ten grains or more have been used, and first then to give salts. The danger of entrance of the contents of the bowels has passed and the derivation to the mucous membrane of the bowels may probably prevent exudation, and therefore suppuration in the peritoneum, while increased peristalsis may probably prevent adhesions. I consider the patients convalescent if I succeed in producing four or five large fluid stools. In cases of chronic appendicitis, again, I consider it proper to use mild laxatives, such as one-tenth grain of podophyllin two or three times a day, the more so as the patients almost always complain of constipation and other gastrointestinal symptoms. Treves recommends salol in ten-grain doses two or three times a day. The only radical treatment is, however, extirpation of the appendix. In regard to local applications, I consider ice more useful in acute cases than poultices. Treves recommends five or six leeches, and states that this measure often has a magical effect if there is present a distinct local swelling with definite dulness and if the local symptoms be pronounced and the fever persists. I have never seen any effect of this measure. Vomiting may often be prevented by sipping very hot water and by ceasing giving food by the stomach. The main point is to make an early diagnosis and to keep the patient absolutely at rest until operation can be performed. I believe, with McBurney, that "no purely medical treatment of actual value in preventing or controlling the disease has yet been presented to the profession."

#### SURGICAL TREATMENT.

It will easily be seen from the preceding pages that I consider appendicitis an exclusively surgical disease, dependent upon bacterial infection, and in the majority of cases independent of the cæcum. The surgical treatment is a great improvement upon the opium treatment or upon the anti-

phlogistic treatment, but it must be used early. It is often a matter of a few hours, not of a few days. I have never yet regretted having operated too early, and I have operated on every case as soon as I was able after the diagnosis was clear; but I have often deplored being called in too late, when the patient already had diffuse peritonitis. I have so far not lost a patient from peritonitis on whom I operated because of chronic appendicitis or acute appendicitis with perforation and local abscess, or even for appendicitis with total gangrene but yet without perforation; but I have saved very few in whom I found gangrene with perforation and diffuse peritonitis at the time of operation. I consider every acute case with the cardinal symptoms, severe pain, vomiting, rigidity, and rising temperature and pulse, particularly if it shows no inclination to recede in twenty-four hours, as ripe for operation. If the pulse continues to increase in frequency and reaches one hundred and fifteen or one hundred and twenty, and stays there, or gets higher, I believe the operation should be done at once. We gain nothing by waiting, we are unable to prophesy the result, and the operation grows more difficult and dangerous with each day of delay, while if done early it has a very small mortality. If, however, the symptoms commence to abate after twenty-four hours, I consider it proper to defer the operation to the quiescent period, after the first attack if the symptoms were severe, after the second attack if light and if a local tenderness and swelling of the appendix be felt on palpation of the appendix by Edebohls's method. I do not consider operation indicated unless we can by palpation satisfy ourselves that the appendix is in a pathological condition. As contraindications I recognize very few, particularly unfavorable surroundings when the patient absolutely refuses to go to the hospital. The operation can safely be done in every clean and well-lighted room when we have proper assistance, re-

liable nursing, and plenty of boiled water; but a well-regulated aseptic operating room in a hospital is the proper place, and, when home surroundings are unfavorable, the condition *sine qua non*. As much depends upon the after-treatment as upon the operation itself. The common precautions of a laparotomy must be observed in every case.

**1. Operation in Perforative Cases with Local Abscess.**—The method of operation in appendicitis with perforation and local abscess depends upon how early we get the case under treatment; in other words, whether we have a large local abscess after a disease of five or six days' up to several weeks' duration, or only a fresh, small, intraperitoneal, limited abscess in the neighborhood of the appendix, with urgent symptoms, or when gangrene is suspected, or else the symptoms of diffused pain and tenderness, rapid weak pulse, and prostration indicate sepsis. "We operate to save life.<sup>1</sup> The main object to be attained when adhesions have formed is to relieve the tension of the abscess cavity by outward drainage, not to do a brilliant operation and lose the patient from general peritonitis. The inexperienced operator should not do too much, but only remove the appendix if he feels sure that its removal will not disseminate pus or destroy the barrier of adhesions." "The proper time to operate is when the inflammation is limited to the appendix, and an operation performed at this period requires a different technique from that employed when there is an abscess or general peritonitis."<sup>2</sup> In the first place, therefore,—*large abscess*,—it is advisable, I believe, simply to incise the abscess and drain it and leave the appendix alone, unless it is readily found and its removal can be accomplished without the risk of infect-

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<sup>1</sup> Van Hook, Journal of the American Medical Association, February 20, 1897.

<sup>2</sup> Murphy, Chicago Clinical Recorder, August, 1897.



ing the abdominal cavity. We will almost always find a large swelling when the disease has lasted one or two weeks, often clear on percussion from the development of gas in the abscess, and extending down to Poupart's ligament, where it terminates with a rounded margin. In such cases, which are usually dependent upon perforation of an appendix lying on the outside of the cæcum or below the cæcum, or else is primarily retrocæcal, the pus will be found either in the retroperitoneal tissue in front of the iliac fascia and behind the transverse fascia, or, if still intraperitoneal, it will have approached the anterior abdominal wall by crowding away the intestines from the lateral region, and the abscess will be walled in by adhesions. It was these forms which gave occasion to the first operations by extraperitoneal incision as advocated by W. Parker,<sup>1</sup> Gauley,<sup>2</sup> and Gurdon Buck.<sup>3</sup>

The incision is best made just above the outer half of Poupart's ligament, three or four inches long. It passes through the skin, the subcutaneous tissue, the fascia of the external oblique muscle, the internal and transverse muscles, and the transverse fascia. (Edema of the deeper tissues is a sure proof of the presence of pus. Having passed through the transverse fascia, we lift up the peritoneum with a finger, if we do not already find pus, and we shall, as a rule, discover the abscess behind the peritoneum in the loose connective tissue. Otherwise we are often able to feel the swelling and fluctuation with the finger behind the peritoneum, as the abscess is then still intraperitoneal, and to open it from behind with a curved trocar or a blunt director.

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<sup>1</sup> An Operation for Abscess of the Appendix Vermiformis Cæci, Medical Record, 1867, vol. ii. p. 25.

<sup>2</sup> Transactions of the Medical Society of the State of New York, 1875, p. 345.

<sup>3</sup> On Abscesses in the Lower Abdominal Cavity and its Parietes, New York, 1876.

There is no danger of opening the peritoneal cavity, as the abscess, even if intraperitoneal, lies between the finger and the peritoneal cavity proper. A slight pressure with the finger alone is often sufficient to rupture the posterior wall of the abscess and make it retroperitoneal. As soon as pus appears an artery forceps is introduced and opened widely; the cavity is carefully explored with the finger for coprolites, lightly irrigated, and two thick drains are introduced. The wound is not sutured, and is dressed in three or four days.

In cases in which the appendix extends inward we may find the tumor nearer the median line, forming a large prominence and not approaching Poupart's ligament. In these cases the incision must be made carefully over the most prominent spot of the tumor through the abdominal wall. The condition of the deeper tissues will show the presence of pus; there are strong adhesions all around, and with blunt instruments we will generally be able to open the abscess without invading the peritoneal cavity; should we, however, happen to invade the healthy peritoneal cavity before opening the abscess, it is advisable to introduce a finger and carefully examine the adhesions in order to find a place where the tumor is broadly adherent to the anterior abdominal wall. We then close the peritoneal wound by sutures and incise in the other place.

*The incision is made higher up* if we get the case earlier, say from the fourth to the seventh day, and find that the swelling does not reach down to Poupart's ligament, but that there is a space of from one-half to one inch between the ligament and the lower margin of the tumor. We may then make a curved incision around the anterior superior spine of the ilium down to the retroperitoneal tissue, lift the peritoneum up, and explore carefully with the finger upward and inward. It is, however, I believe, preferable in these cases to make *laparotomy* by oblique incision through the

muscles, about one inch inside the anterior superior iliac spine, so that we approach the abscess from the lateral margin, where we frequently will meet with the strongest adhesions. There is probably not much pus present, and we are perfectly able, even if we find no adhesions and therefore primarily enter the abdominal cavity, to open the abscess without infecting the peritoneal cavity by carefully packing antiseptic gauze and sponges beneath the margins of the wound. The adhesions are thereafter loosened slightly with the finger-nail or a blunt instrument till pus commences to appear, when it is rapidly mopped up with sponges as fast as it appears in the little opening made. After all the pus is out the adhesions are loosened more extensively, the cavity is carefully explored for concretions, and the appendix is then removed, if it be found in a place where this can be done without incurring any additional risk to the patient, particularly if found on the outside of the cæcum; we run, however, too much risk of rupturing the wall of the abscess and of infecting the peritoneal cavity if we try to remove it when it extends inward. The cavity is thereafter carefully mopped clean with aseptic sponges held in an artery-forceps, drained with a wick-drain, and the upper and lower ends of the wound are sutured with a couple of strands of silk-worm-gut.

In *still earlier cases*, in which the operation is performed on the second or third day, or earlier, on account of serious symptoms of perforation, which do not recede or indicate gangrene or septic lymphangitis, we perform a strict laparotomy. The point here is to expose the appendix and remove it in order to prevent more serious complications, and the incision should be so placed that the appendix may readily be removed, the surrounding tissues thoroughly cleansed, and the whole area properly treated with completeness and safety. The appendix lies at the point of greatest tenderness, and

the incision, as a rule, is made over this point, whether it be up towards the liver, in the normal position, or downward near the pelvis. We shall usually, under anæsthesia, be able to feel a little hardness and form a pretty correct idea about the position of the appendix. If we expect to find pus, I believe it safer to make the incision over the cæcum in an oblique direction, four inches long and one and one-half inches to the inner side of the anterior superior spine of the ilium, half of the incision lying above and half below the line from the anterior superior iliac spine to the umbilicus. We split the fibres of the external oblique fascia, cut the internal oblique and the transverse muscles for about three inches, then the transverse fascia, and lastly the peritoneum. We evacuate first any sero-fibrinous or sero-purulent exudation which may be found in the peritoneal cavity by carefully mopping it up with aseptic sponges, and thereafter protect the peritoneal cavity with sterilized gauze introduced under the margins of the wound and held in place by the fingers of the assistants, who with the gauze crowd the bowels away from the wound. I always introduce a large sponge in an artery forceps down towards the pelvis, in order particularly to protect this region. We are now generally able to see where we may expect to find the appendix by fresh adhesions and agglutinations, and we loosen these carefully, mop up the small amount of pus found, dilate the opening, and disinfect the cavity and its surroundings with hydrogen peroxide. The appendix is then isolated with the fingers and blunt instruments. As a rule, we find it with ease by following downward one of the longitudinal bands of the cæcum, which leads directly to the appendix. If the mesentery is retracted and swollen, it may be easiest to ligate the appendix doubly, sever with scissors, and then loosen the outer part with blunt instruments till we can ligate the mesentery and remove the appendix. It is, how-

ever, more advantageous to commence to loosen the tip of the appendix and bring it and the end of the cæcum out through the wound, ligate the mesentery in sections, and then sever the appendix. It is of importance to ligate in healthy tissue in order to prevent fecal fistulas. It may now and then be necessary to resect part of the cæcum in order to get into healthy tissue, particularly when the appendix is gangrenous near its insertion into the cæcum.

*Treatment of the Stump.*—Dr. Robert Dawbarn,<sup>1</sup> of New York, has devised a method which I have tried in a large number of cases and which has unusual advantages in proper cases. The method is as follows : first, a circular, continuous Lembert's silk suture is introduced through the superficial layers of the cæcum a quarter of an inch from the insertion of the appendix, and tied loosely, the meso-appendix previously having been ligated and severed ; second, the appendix is thereafter amputated half an inch or more from the insertion ; third, the stump of the appendix is dilated by introducing through it a fine forceps into the cæcum and gradually opening the forceps, whereby we dilate possible strictures and make the following step easier to perform ; fourth, the stump of the appendix is caught with a fine-toothed forceps and invaginated half an inch into the cæcum, while we press the cæcum against the forceps with a couple of fingers of the other hand ; fifth, the circular suture is tied firmly and the toothed forceps removed. The advantages are, of course, that the serous surfaces are in apposition on account of the invagination, instead of the infected mucous surfaces as when we simply apply a ligature around the stump. We cannot use the method if we find the appendix very stiff and thickened or gangrenous near its insertion, nor if the wall of the cæcum is inflamed. Dawbarn advises, in that eventuality, to

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<sup>1</sup> Medical Record, August 31, 1895.

apply another circular suture one-quarter of an inch farther away from the first. The method will prevent cæcal fistulas, and the longer the stump is and the more the serous surfaces, therefore, are in apposition, the surer the result. The method has its place particularly in chronic, recurring cases, but it is exceedingly useful in acute cases, too, if the inner half-inch of the appendix is normal. Otherwise we will have to be satisfied with ligating the appendix with silk, having first, if possible, stripped the serous membrane back, disinfected the stump by scraping away the mucous membrane, and cauterized it with nitric or carbolic acid. The silk ligature is then applied around the mucous membrane and cut short, the serous membrane pulled down and united over the stump with a couple of Lembert's sutures, and the stump, lastly, invaginated in the wall of the cæcum with a few sutures or covered by a piece of the omentum. If the inner end of the appendix, however, is more or less diseased, we may have to be satisfied with ligating it with silk and disinfecting the cavity, and then surrounding it with iodoform gauze led out through the wound. Fowler<sup>1</sup> does not favor Dawbarn's method, as in one case, in which the patient died ten days later from pulmonary complications, he found the invagination to have taken place between the muscular and serous coats of the cæcum. In another case he met with repeated hemorrhages from the bowels, due presumably to an artery in the wall of the appendix. I have occasionally seen arterial bleeding from the stump of the appendix, but have always ligated the vessel before invaginating the stump. Edebohls<sup>2</sup> has recommended the inversion of the normal appendix as a precautionary measure whenever the abdomen

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<sup>1</sup> Typical Excision versus Inversion of the Vermiform Appendix, American Journal of the Medical Sciences, February, 1897.

<sup>2</sup> American Journal of the Medical Sciences, June, 1895.



is opened, provided the incision renders the appendix easily accessible. It requires less than five minutes' time and is absolutely free from risk, the appendix not being opened. The meso-appendix is tied with catgut close to the base of the appendix. The excess of meso-appendix beyond the ligature is cut away and the appendix freed down to its base. The assistant grasps the cæcum with the index-finger and thumb just above and below the origin of the appendix, the hole through which the appendix is to be inverted thus lying between his fingers. The operator seizes the appendix near its base with forceps and inverts first the proximal part of the appendix, holding the inverted part in while the forceps grasps another portion of the appendix and pushes it in after the first, and so on, until the tip is pushed inside the peritoneal mouth. The partly inverted appendix is thereafter grasped through the walls of the cæcum and the inversion perfected by "milking" the appendix till we feel it completely inverted through the walls of the cæcum. The peritoneal mouth is closed with a suture enclosing the severed meso-appendix. I have in several cases satisfied myself of the ease with which this procedure is done. Baldwin<sup>1</sup> has practised inversion as a precautionary measure in more than one hundred cases, beginning, however, with the tip instead of with the base of the appendix.

The stump having been disposed of and parts of the omentum removed if gangrenous, the field is properly disinfected. I consider it of importance thereafter in all suspicious cases, particularly if perforation is present, to introduce a finger down into the pelvic cavity, unless closed by adhesions, to convince ourselves that there is no stagnant exudation there. The peritoneal cavity must be thoroughly washed out with sterilized salt solution if we find a sero-

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<sup>1</sup> Medical Record, January 20, 1900.

fibrinous or purulent exudation in the pelvis. A glass or aluminum drainage-tube, containing a strip of dry sterilized gauze for capillary drainage, is thereafter introduced down to the bottom of Douglas's fossa, the surroundings of the appendix are packed with iodoform gauze, and the wound is left open or partly sutured and covered with dry sterilized gauze, particularly around the end of the capillary drain, which is changed when soaked through. The drainage-tube is removed as soon as the capillary drain remains dry. In three or four days the iodoform gauze packing is removed, the cavity disinfected, and a smaller packing applied until healthy granulations appear. The wound may then be closed with secondary sutures. I consider this treatment the proper one in all early cases in which we find pus, gangrene, and beginning sepsis. Sonnenburg<sup>1</sup> operated formerly in two steps, but uses this method now only in cases with considerable meteorism and but indistinct resistance, which is deep and inaccessible to palpation. He incises then down to the peritoneum, plugs with iodoform gauze, and tries some days later to find the increasing exudation by exploratory puncture, if necessary. I consider this plan lacking all advantages. It is just such cases, with severe meteorism and slight resistance, which, as a rule, are the most serious, and in which perforation has occurred and septic peritonitis is present. They demand prompt laparotomy, with extirpation of the appendix and washing out of the peritoneal cavity, and they demand it promptly, and not the day after to-morrow. We are perfectly able to protect the peritoneal cavity with sponges and aseptic gauze while we search for the pus and evacuate it, if it still should happen to be limited by adhesions, and we are perfectly able to clean the peritoneal cavity if during the operation some pus should

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<sup>1</sup> Volkmann's *Klinische Vorträge*, neue Folge, No. 13, 1891, S. 79.

enter an otherwise healthy peritoneal cavity. The patient will unquestionably die while we wait for increasing exudation, if perforation with commencing septic peritonitis is present, instead of a local abscess. He operates in most cases, however, in one step: opens the abscess as broadly as possible, searches out the appendix under all circumstances, and removes it in every case when possible. I have already stated as my opinion and that of many prominent surgeons that, however desirable, it is unnecessary and may be positively dangerous to remove the appendix in some circumstances. Sonnenburg's incision is also in my opinion objectionable. He incises from just above the anterior superior spine of the ilium down to the anterior inferior spine of the ilium and then in a slight curve down to the middle of Poupart's ligament. This incision probably gives less occasion to ventral hernia, but it is a great deal easier to find one's bearings and meet difficulties when we use an oblique incision through the muscles one or two inches inside the anterior superior spine of the ilium. I use an incision similar to that of Sonnenburg in cases in which the abscess has extended down to Poupart's ligament and in which the operation is only a simple oncotomy, but I would never advise its employment when the intention is to find and remove the appendix itself. Willy Meyer<sup>1</sup> recommends a modified incision in cases complicated with ovarian or Fallopian troubles or in which the appendix extends down in the pelvis or inward towards the linea alba. He calls it the Hockey-Stick incision, and commences it one-half inch above and midway between McBurney's point and the anterior superior spine, and carries it down to one-half or three-quarters of an inch from Poupart's ligament over the line of the femoral artery. The lower end of the incision is then, if necessary,

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<sup>1</sup> Journal of the American Medical Association, February 17, 1900.

extended in a horizontal line inward to the border of the right rectus muscle or even farther, the belly of the rectus muscle being drawn inward and the peritoneum beneath it being incised in the same direction. Intrapelvic manipulations are then easily performed.

2. In chronic recurring cases or in early acute cases in which we do not expect to find pus, the incision, in my experience, is best made through the sheath of the rectus muscle one-quarter of an inch inside the margin of the muscle. McBurney<sup>1</sup> advises against opening the sheath of the rectus, as there is bleeding from twigs of the deep epigastric artery and as it interferes with the subsequent neat apposition of the edges of the wound. It is, therefore, he says, better to place the incision just external to the commencement of the tendinous fibres, beginning the incision about one inch above a line from the anterior superior iliac spine to the umbilicus and corresponding to a line parallel to and half an inch to the right of the edge of the rectus muscle. The aponeurosis of the external oblique is separated without cutting its fibres transversely, the tendinous parts of the internal oblique and of the transverse muscles are divided for two inches, and the transverse fascia, the retroperitoneal fatty tissue, and the peritoneum are cut through for the same distance. I prefer, however, to open the sheath of the rectus muscle and pull the muscle inward. The branches of the deep epigastric artery are plainly seen and are ligated before being cut; behind the muscle we find first the fascia transversalis and then the peritoneum. The structures, after the operation is finished, are easily brought into apposition and sutured with rows of sutures, first the peritoneum and then the fascia transversalis. The rectus muscle is then replaced, the sheath neatly sutured, thereafter

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<sup>1</sup> Dennis's System of Surgery, 1896, vol. iv. p. 418.

the aponeurosis of the external oblique, and lastly the skin. I use no drainage, and the wound has in every case healed by first intention. The rectus muscle lying in front of the deeper part of the wound prevents all inclination to hernia, which, in spite of the neat apposition and suture, may occur in McBurney's incision along the outer margin of the rectus, where all the structures severed are tendinous. The peritoneal cavity having been opened, the appendix is loosened, brought out through the wound with the lower end of the cæcum, amputated and invaginated, and the wound closed as described, without drainage. Kammerer,<sup>1</sup> has advised the same incision.

Morris<sup>2</sup> advises in these cases an incision one and one-half inches long in the right semilunar line, and allows his patients to get up in a week and a half. The short incision absolutely prevents ventral hernia, and even the scar disappears by careful suturing. While it is possible in uncomplicated cases without adhesions to extirpate the appendix through this short incision, it has, in my opinion, no advantage over other methods, and makes the operation more difficult. Trendelenburg's position is often of advantage where no pus is present.

McBurney,<sup>3</sup> in order to avoid the damage to the abdominal wall by cutting transversely through the fibres of the muscles and to allow a more perfect replacement of the parts disturbed, has devised the following operation to be used where complete closing of the wound is permissible. Skin incision about three inches long, beginning one inch above the line from the anterior superior iliac spine to the umbilicus, crossing this line in a right angle one and one-

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<sup>1</sup> *Annals of Surgery*, August, 1897.

<sup>2</sup> *Loc. cit.*

<sup>3</sup> *Dennis's System of Surgery*, 1896, vol. iv. p. 421; *International Text-Book of Surgery*, Philadelphia, 1900, vol. ii. p. 414.

half inches internal to the anterior superior iliac spine, and passing obliquely downward. The fibres of the external oblique muscle are separated bluntly and retracted with two lateral wound-retractors. We meet then the internal oblique and transverse muscles, whose fibres cross those of the external oblique, and these muscles are also separated bluntly and retracted with wound-retractors upward and downward. The wound which originally was vertical is now transverse, and the peritoneum is opened in a transverse direction and the appendix found and removed. If not so found, the cæcum is pulled out and the appendix located in the usual way. The peritoneum and the transverse fascia are then sewed together with a continuous catgut suture, the different muscles smoothed out in the different planes with the fingers, four or five approximation sutures applied to the separated internal oblique and transversalis muscles, and lastly the skin incision is sutured. The muscles quickly regain their tone, and ventral hernia is impossible. I have tried this method several times in uncomplicated cases successfully. It is, however, more difficult than the incision through the rectus, gives very little space, requires more time, and is out of place if we should meet pus.

3. Retrocæcal Abscesses.—The swelling is much deeper and indistinct at the commencement in cases in which an appendix is attacked which lies behind the cæcum and in reality is retroperitoneal. We find the most severe pain in these cases by deep pressure in the lumbar region over Petit's triangle, with little or no tenderness over McBurney's point, fulness and rigidity in the right flank of the tumor, and resistance in the appendicular region. The incision ought in these cases to be made from behind or in the lateral region, and we may without danger explore with a hypodermic needle in different directions in order to find pus. It is just in these cases that the abscess may develop to an



enormous degree and extend upward behind the kidney,—even up to the liver. Should it happen in such a case that we misjudge the position of the abscess and make laparotomy, we ought, of course, to close the laparotomy wound and incise from behind as soon as we discover our mistake. These cases, however, will rarely be submitted to early operation: there are no urgent indications, and we have time to wait without endangering the life of the patient. Grinda<sup>1</sup> recommends in these cases a lumbo-iliac incision running from the external border of the sacrolumbalis muscle forward, about one inch above the iliac crest to within one and one-quarter inches of the anterior superior iliac spine. The wound drains well, and hernia does not tend to follow the operation.

4. Operation in Diffuse Peritonitis.—The prognosis in diffuse cases depends absolutely upon the time of operation. Richardson<sup>2</sup> is convinced that in all serious cases there is perforation present from the very beginning, and that the first symptoms depend upon perforation and not upon catarrhal and ulcerative processes in the mucous membrane. This view is, however, not correct. I have in a number of cases met a gangrenous, but still not perforated, appendix at early operations, and the prognosis is quite favorable, at least I have not lost any of these patients from peritonitis. The prognosis is still moderately favorable by early operation, if perforation occurs without limiting exudations, but a small opening, and there is stricture of the appendix present, which prevents the contents of the bowels from flowing out; but it depends often upon a few hours whether or not we are able to save the patients. The case is about hopeless if we find a large perforation with direct communication with the

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<sup>1</sup> Médecine Moderne, No. 71, in Gould's Yearbook of 1899.

<sup>2</sup> Loc. cit.

cæcum, through which the contents of the bowels flow out in a steady stream. We may in these cases, by early operation, find a sero-fecal, badly smelling exudation in the peritoneal cavity, but still without exudations of lymph, and we hope for the best. We find, nevertheless, as a rule, that the peritonitis progresses in spite of laparotomy. These cases are probably fatal from the time of perforation, on account of the violent infection. Richardson compares them, and not without reason, to gunshot wounds of the bowels. Our only reliable resource is to forestall perforation or else to operate as early as possible.

McBurney<sup>1</sup> advises an incision four or five inches long, as near the anterior superior spine of the ilium and the outer part of Poupart's ligament as possible. All fluid possible is removed from the peritoneal cavity with sponges, and the appendix thereafter extirpated. All purulent or sero-purulent products are then sponged away as thoroughly as possible from the pelvis, between the coils, up towards the liver, etc., and the abdominal cavity is thereafter irrigated with sterilized salt solution of the usual strength,—*i.e.*, six-tenths per cent.,—the solution being as hot as can comfortably be borne by the operator's hand, and the irrigation being continued in different directions until the fluid returns perfectly clear. The pelvis is thereafter sponged as dry as possible, and a long glass drainage-tube, containing a strip of dry sterilized gauze for capillary drainage, passed to the bottom of the pelvis. Meshes of iodoform gauze are passed up in different directions according to where pus is found, the wound is plugged down to the stump with iodoform gauze, without being sutured, and dressed with sterilized gauze, which is changed when soaked through. I prefer, however, drains of dry sterilized gauze, surrounded in the middle by

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<sup>1</sup> Medical Record, March 30, 1895.

rubber tissue-paper, to the iodoform gauze, which becomes strongly adherent by granulations growing into its meshes. Severe bleeding is caused by its removal, and the fresh adhesions are torn in the surroundings. The glass tube in the pelvis is cleaned every few hours and removed in twenty-four or thirty-six hours, the deep packing in from three to five days. The patient is fed by nutritive enemata, the flatulence treated by a large soap-and-water enema after twenty-four hours, and laxatives are used only when the enema is ineffectual. This is essentially the treatment I have been in the habit of using, except that I use laxatives earlier after the operation, and frequently, for the purpose of effectually washing out and draining the peritoneal cavity, incise in both flanks. Sonnenburg<sup>1</sup> considers a direct surgical treatment useless in these cases, and prefers to make a large opening over the original trouble and thus relieve the tension; but not to operate on the peritonitis itself by incision in the middle line, as we run the risk of opening up intact parts of the peritoneum, and as he considers drainage of the peritoneal cavity an illusion. Monod<sup>2</sup> considers median incision preferable, except in cases in which there is doubt of the peritonitis being general, and when the symptoms are predominant in the appendicular region. A lateral incision may be done secondarily in order to remove the appendix with greater facility or for the purpose of drainage.

McBurney had in twenty-four cases fourteen recoveries,—*i.e.*, a mortality of forty per cent.; Richardson,<sup>3</sup> nine recoveries in thirty-two cases,—*i.e.*, seventy-five per cent. mortality; Fenger had ten deaths in eleven cases; Mikulicz, nine

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<sup>1</sup> Mittheilungen aus den Grenzgebieten der Med. und Chirur., Band iii., 98, S. 10.

<sup>2</sup> Monod et Vanverts, Appendicite, Paris, 1897.

<sup>3</sup> American Journal of the Medical Sciences, January, 1894.

deaths in thirteen cases ; Sonnenburg, thirty-six cases with seventy-five per cent. mortality ; Willy Meyer<sup>1</sup> saved three out four, when operated on inside of twelve hours after perforation, while all died who were operated on later. I have had forty-seven cases with nineteen recoveries,—*i.e.*, sixty per cent. mortality.

Dawbarn<sup>2</sup> found in a case after laparotomy fluid fæces and stinking pus everywhere between the bowels and down in the pelvis, and the bowels were exceedingly congested and inflamed. The appendix was gangrenous, except the inner quarter, and perforated at several points, through which fluid fæces streamed out. He amputated the appendix and then enlarged the wound to a length of seven inches, and eviscerated the patient as perfectly as possible, so that almost all the bowels were outside the abdominal cavity. He cleansed them perfectly with warm salt solution, irrigated the empty peritoneal cavity everywhere, then replaced the bowels and partly sutured the wound, leaving open the middle part, through which numerous sterilized gauze tampons were introduced in different directions. The patient recovered. This case shows that we cannot be too thorough in desperate cases with large perforations and entrance of fæces into the abdominal cavity. They are absolutely fatal without operation, and this gives them their only chance, even though a poor one.

The successful cases of Morris<sup>3</sup> depended, without doubt, upon the thoroughness with which he disinfected the bowels and upon his extensive use of drains. He advises, when the peritoneal cavity is filled with pus and exudations of lymph, to irrigate first with five hundred or one thousand grammes of hydrogen peroxide in different directions, and two or

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<sup>1</sup> Medical Record, February 29, 1896.

<sup>2</sup> Ibid, August 31, 1895.    <sup>3</sup> Loc. cit.

three minutes later to wash out with a few gallons of warm salt solution. In cases of extensive adhesions of the bowels by fresh exudations of lymph and multiple small collections of lymph between the adherent bowels, he introduces the whole hand and loosens thoroughly all adhesions before injecting the hydrogen peroxide. He saved a moribund patient by this proceeding.

The question of *Drainage* is still under discussion, although most surgeons advocate its extensive use. Bode,<sup>1</sup> of the City Hospital at Frankfort, recommends a method of drainage in general peritonitis which, it seems to me, may be tried with advantage, whatever is the cause of the peritonitis. He removes the entire contents of the peritoneal cavity after a median incision and with the pelvis elevated, under constant sprinkling with warm salt solution. During this proceeding, he states, the weak and rapid pulse becomes fuller, probably from diminished intraperitoneal pressure and removal of toxic products, and peristaltic movements are frequently seen. The empty peritoneal cavity is now thoroughly washed out with from thirty to forty litres of the salt solution, with special attention to the regions of the liver, spleen, and pelvis, and the fluid gently mopped up with compresses. The intestines are thereafter replaced under continuous sprinkling with the salt solution. A loop of the small intestines about the centre is thereafter lifted up and a slit made in its mesentery near the root of the mesentery. A long drainage-tube with a number of openings near the centre is passed through the slit, forming an arch as the loop is replaced, the ends of the tube passing through the peritoneal cavity and emerging from two new incisions to the left and right above the colon. Other tubes are inserted through incisions in each flank, one down in the pelvis through the lowest point of the median incision, and

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<sup>1</sup> Centralblatt für Chirurgie, January 13, 1900.

another in the liver, stomach, or spleen regions, if indicated. The abdomen is thereafter closed, a considerable quantity of the salt solution being left in it. The patient is put to bed with head and shoulders raised, and the abdomen is rinsed out two or three times a day with from one thousand to fifteen hundred cubic centimetres of the salt solution. The author states that in this way it is possible to evacuate considerable quantities of pus from the abdomen in seventy-two hours without material discomfort to the patient, that the rinsing is frequently followed by increased peristaltic movements and passage of flatus, and that even permanent irrigation through the main tube may be used. Serious symptoms usually disappear by the third or fourth day, and the course of the peritonitis is remarkably smooth and convalescence extremely short. Finney<sup>1</sup> reports five successful cases of general suppurative peritonitis—four from appendicitis and one from typhoid perforation—treated by a similar method: incision in the right semilunar line, withdrawal of the coils of the small intestines, cleansing of the peritoneal cavity thoroughly and systematically with large pledgets of gauze wrung out in hot salt solution and flushing with the same solution, examining and cleaning the small intestines by wiping with gauze compresses under a constant irrigation of warm salt solution, replacing the intestines and closing the abdominal wound, just enough room being left between two sutures for a gauze drain. He advises to move the bowels early by calomel in broken doses, followed by salts and turpentine enema, and to apply the Paquelin cautery thoroughly on the abdomen if there be evidence of distention or pain. Fowler<sup>2</sup> elevates the head and trunk and drains the pelvic cavity, at least, by properly placed glass drains. He thinks

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<sup>1</sup> Johns Hopkins Hospital Bulletin, July, 1897.

<sup>2</sup> Medical Record, April 14, 1900.



that transference of the septic fluids from the upper dangerous areas of the peritoneal cavity to a less dangerous region (the pelvis), and removing the fluids from the latter by proper means of drainage, is not only a rational but an imperatively demanded procedure. Nine cases are reported (all successful) in which this method was used.

Barthold Carlson<sup>1</sup> advises to incise first parallel with the right Poupart's ligament, thereafter to introduce three fingers through the wound towards the middle line, and incise here against the fingers; lastly, introduce again three fingers through this wound and incise in the left flank, but considerably higher up and transversely, in order with greater ease to be able to drain the median side of the descending colon without compressing the colon. Thereafter he removes the appendix and the omentum, which he considers it impossible to disinfect. The peritoneal cavity is then irrigated with hot salt solution, and the cavity dried with compresses soaked in the salt solution and fibrinous deposits removed. For drainage he uses gauze compresses in both iliac regions, smaller gauze drains along the outer and inner sides of both ascending and descending colon, and a large rubber drain surrounded with gauze down into the pelvis. The incisions are left partly or wholly open, and the outer dressing is changed every three or four hours.

**After-Treatment.**—Floderus,<sup>2</sup> from Lennander's clinic in Upsala, gives certain rules in regard to the treatment after laparotomy for diffuse peritonitis, which have done me good service. Two indications present themselves: one to stimulate the patient and maintain his strength and the heart's action, another to remove the infectious products as quickly as possible. The stimulating treatment consists in a subcu-

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<sup>1</sup> Hygieia, November, 1898.

<sup>2</sup> Archiv für Klinische Chirurgie, 1897, S. 55.

taneous injection of camphorated oil (one gramme) every three hours, and a nourishing enema, consisting of fifteen grammes of grape sugar, forty-five grammes of brandy, one hundred and fifty grammes of water, and one gramme of tincture of digitalis, if indicated, every four hours, by which peristaltic movements are caused without irritating the rectum. At the same time transfusion of one pint of salt solution is used several times daily, in order to increase the blood-pressure and the diuresis. The infectious micro-organisms and their toxins are not eliminated by drainage alone; it is necessary to increase the diuresis by means of digitalis, camphor, and transfusion. The peristaltic motions should be restored as quickly as possible. If the intestines are distended, they are punctured and their septic contents evacuated. For the same purpose calomel is given by the mouth in one-grain doses every two hours, unless vomiting occurs, followed next day by salts. Frequent washing out of the colon is practised, and no food is allowed by the mouth until peristaltic power is re-established. Morphine should never be used unless the pain is unbearable, and then only subcutaneously in doses of one-sixth of a grain, as it prevents peristalsis. The drains are left in four or six days, unless there is increasing temperature.

**Fæcal Fistulæ.**—They generally heal spontaneously if left alone, unless a concretion or an unabsorbed ligature lies at the bottom of the tract or so much of the bowel has sloughed away that the resulting fistula has a large lumen. The only safe operation consists in entering the abdominal cavity through some other point than through the fistula itself. To enlarge the fistulous opening will lead to wounding of the intestines, but an opening about the fistula can be made easily and with safety.<sup>1</sup>

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<sup>1</sup> McBurney, New York Polyclinic, January 15, 1897.

Morris<sup>1</sup> states that it is sometimes advisable to operate for the comfort of the patient when recovery is slow. The operation is a simple one. The first step consists in preparing for an aseptic operation. The lumen of the fistula is plugged with gauze, and the incision through the skin includes the entire scar, so that the patient can have the benefit of removal of the scar as well as the fistula. The first landmark in the incision is the external oblique aponeurosis, the last is a part of the peritoneum free from adhesions. The peritoneal cavity having been opened, adhesions are separated and the part of the bowel to which the wall of the fistula and the scar are attached is exposed. The wall of the fistula is ligated close to the bowel very much as we ligate an appendix. The peritoneum of the bowel is well scarified at the part that is to be included in sutures; the wall of the fistula and the scar are severed in one mass, and the scarified portion of the bowel is closed by Lembert's sutures, or by a puckering string suture. The peritoneum of the abdominal wall is then closed nicely with catgut. The internal oblique and transversalis muscles are accurately approximated by means of another suture. The external oblique aponeurosis requires a perfect suture because its line of traction is different from that of the deeper muscles. A subcuticular one closes the skin wound, and the patient recovers easily without a fistula and without a disfiguring cicatrix.

It may, lastly, have its advantages to open the abscess from the rectum or vagina when in late cases we find the abscess prominent there. It is one of the methods which nature brings into use in neglected cases. I would, however, hesitate to open an abscess from appendicitis through the rectum.

My conclusions in regard to the modes of operation are, therefore, that we do not possess any method which gives

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<sup>1</sup> Post-Graduate, New York, February, 1900.

satisfaction in all cases ; but that, on the contrary, every case must be studied by itself, and the method chosen which, with least danger to the patient, enables us to evacuate the pus, remove the appendix where this is indicated, and thoroughly disinfect the bowels and the peritoneal cavity where we find peritonitis present.

As *general conclusions*, I state as my opinion, based upon a large experience and careful perusal of the surgical literature, that there is a point of time in every case of appendicitis at which recovery is possible by operation. The prognosis depends solely upon this point of time. We will save our patients if we operate before perforation with resulting diffuse peritonitis has occurred. They will, as a rule, die in spite of the operation if we wait till diffuse peritonitis is present. It is often a question of a few hours, rarely of a few days. We ought immediately to operate in every case which commences with acute severe pain, vomiting, rigidity, fever, and does not recede inside of twenty-four hours, as we cannot know positively the condition of the appendix, or whether there is commencing gangrene or even perforation present. We cannot operate too early ; we are often too late. Medical treatment is unable to prevent gangrene or perforation, or to save the patient after peritonitis has occurred ; the only reliable help to be found is in surgical treatment. The earlier the operation is performed the better is the prognosis and the surer the recovery,—a recovery, too, which is radical.

### STATISTICS.

I add statistics of one hundred and eighty-five personally operated cases. These by no means represent all the cases I have operated on, but only those of which I have, with a few exceptions, conducted the after-treatment myself. I have, besides, operated on many patients in the country and

surrounding towns, but I saw them only during the operation and have no histories of these cases. I will also call attention to the fact that all the laparotomies—one hundred and fifty-eight in number—were performed since 1893. Before that time I saw only cases with perforation and large local abscesses, which all recovered by extraperitoneal operation. Cases of gangrene, perforation, and diffuse peritonitis did not then come under my notice, as they died at their homes under medical treatment. I have seen very few cases with large local abscesses during the last three or four years. Cases are diagnosed earlier and treated by laparotomy while the abscess is still small.

The first group—appendicitis with localized abscess—is represented by thirty-four cases, twenty-four of which were males and ten females. One was under ten years of age, fifteen between ten and twenty years, nine between twenty and thirty years, six between thirty and forty years, one between forty and fifty years, and two above fifty years of age. Laparotomy with extirpation of the appendix was performed in seven cases, all of which recovered. One was operated on the first day, one on the second, two on the fourth, two on the sixth, and one in the second week. Incision with drainage was performed in twenty-seven cases, three of which died, one suddenly from an embolus from the iliac vein, one of sepsis, and one of exhaustion shortly after opening, in the fourth week, without narcosis, an enormous retrocæcal abscess which had been overlooked by the attending physician. Six were operated on on the fifth day, six on the sixth day, three on the seventh day, eleven in the second week, and one in the fourth week. Two of these twenty-seven cases relapsed inside of three months, and had their appendices removed during the first twenty-four hours of the relapse. In the seven appendices removed, there was one case of stricture, two of empyema, two of coprolites, one of acute bend, and one of ulceration. One had an extensive

gangrene of the cæcum with subsequent formation of cæcal fistula, which healed by itself. Three of the thirty-four had had one previous attack, three two previous attacks, five three previous attacks, three many previous attacks, and twenty had never suffered from appendicitis before.

The second group is represented by thirty-four cases, all of which had more or less total gangrene, but yet without perforation. Twenty-six were males and eight females. Four were between five and ten years of age, twelve between ten and twenty years, thirteen between twenty and thirty years, four between thirty and forty years, and one between forty and fifty years. Fifteen had had previous attacks and nineteen none. Two had had one previous attack, three two previous attacks, two three previous attacks, and eight many previous attacks. Strictures were found in seventeen cases, empyema in fourteen, coprolites in nine, acute bends in one, and ulceration in one. Thirty-two recovered, of which five were operated on inside of twenty-four hours, twelve on the second day, eight on the third day, two on the fourth day, three on the fifth day, and two on the sixth day. Two died, operated on on the third and fifth days. One of these died eight days after the operation from hemorrhage from a mesenteric vein, and one on the third day after the operation from pylephlebitis suppurativa. Two had as complications gangrene of the cæcum, one of which died of mesenteric hemorrhage, one developed jaundice, and one a fecal fistula which healed by itself. No one can doubt that perforation with diffuse peritonitis would have occurred in them all, and that they all would have died by any other than surgical treatment.

The third group is represented by forty-seven cases, all of which had gangrene with perforation and beginning or diffuse peritonitis. Thirty-one were males, sixteen females. Six were under ten years of age, sixteen from ten to twenty years, thirteen from twenty to thirty years, five from thirty



to forty years, five from forty to fifty years, and two above fifty years of age. Thirteen cases had strictures, seven empyemas, and twenty-two coprolites. Seven had had one previous attack, four had had two previous attacks, four had had three previous attacks, two had had many previous attacks, and twenty-six had never had a previous attack. Five were operated on during the first twenty-four hours, and all recovered. Fifteen were operated on on the second day, of which ten recovered and five died. Seven were operated on on the third day, of which three recovered and four died. Five were operated on on the fourth day, five on the fifth day, seven on the sixth day, two on the seventh day, and one in the second week, and *they all died*. This shows that the third day is the critical one in the disease, and that the danger lies in the disease, not in the operation. All who were operated on on the fourth day or later died in spite of the operation. In two of these cases the symptoms were those of septic lymphangitis. One recovered by immediate operation, the other, in which the operation was put off for twenty-four hours, died. The mortality of all of the forty-seven cases was fifty-nine and five-tenths per cent. Three died of gangrene of the cæcum, and one of pylephlebitis suppurativa after the peritonitis had ceased, the rest of diffuse peritonitis.

The fourth group is represented by sixty-six cases, all of which suffered from chronic recurring appendicitis. The appendix was removed fifteen times during acute exacerbations and fifty-one times in the interval. Four of these last had appendicitis obliterans. Fourteen were between ten and twenty years, thirty-one between twenty and thirty years, seventeen between thirty and forty years, three between forty and fifty years, and one between fifty and sixty years of age. Forty-three were males and twenty-three females. Strictures were found in thirty-eight cases, empyema in seven cases, hydrops in twenty cases, coprolites in twelve cases, bends and kinks in eight cases, ulcerations in eight cases, and

tuberculosis in two cases. Thirteen had had one previous attack, seven two attacks, eleven three attacks, twenty-three many attacks, and twelve had never to their knowledge had an attack of appendicitis. One had an attack of phlebitis of the left femoral vein after the operation, one had the appendix attached to the gall-bladder and had had many attacks of supposed gallstone colic. Two suffered from ileus before the operation, one of which died, one had hæmatosalpinx and degenerated cystic ovaries complicating the appendicitis, and one had a long-standing fecal fistula from tuberculosis before the operation. Sixty-three recovered and three died, one from intervening meningitis and one after a delayed operation for ileus dependent upon a chronic appendicitis. In neither was the operation at fault. The third case, however, died as the result of a shock from the operation. The patient, a girl of thirteen years, had for two years suffered from a great many attacks. The appendix was with difficulty found up under the liver, firmly attached by old adhesions, and the cæcum was drawn upward by the adhesions so that the lower end pointed upward towards the liver. The operation was tedious and of long duration, the condition being poor and the operation necessary. The appendix contained a large coprolite and some muco-pus.

A fifth group consisted of four cases which suffered from acute catarrhal appendicitis. One was between five and ten years of age, two between ten and twenty years, and one between twenty and thirty years. Two were males and two females. One was operated on on the second day, one on the third day, one on the fourth day, and one on the sixth day after the beginning of the symptoms. One had had a previous attack, three none. The appendix was found in a state of catarrhal inflammation in them all, but without special pathological changes. They all recovered promptly by the operation, but two of them had moderate attacks of icterus after the operation.

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